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Review Article

Review of the Freshwater Catfishes of Iran (Order Siluriformes)

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Abstract: The systematics, morphology, distribution, biology, economic importance and conservation of the freshwater catfishes of Iran are described, the species are illustrated, and a bibliography on these fishes is provided. There are four families with four genera and six species, one of which is an exotic; the family Bagridae with one genus and species, *Mystus pelusius* in the Persian Gulf, Hormuz and Tigris River basins; the family Heteropneustidae with one genus and species, *Heteropneustes fossilis* in the Tigris River basin; the family Siluridae with one genus and two species, *Silurus glanis* in the Caspian Sea, Lake Orumiyeh and Hari River basins and *Silurus triostegus* in the Tigris River basin; and the family Sisoridae with one genus and two species, *Glyptothorax kurdistanicus* in the Tigris River basin and *Glyptothorax silviae* in the Persian Gulf and Tigris River basins. There are also some species in the neighboring regions which were not reported from Iran.

Keywords: Bagridae, Biology, Heteropneustidae, Morphology, Siluridae, Sisoridae.

Introduction

The freshwater ichthyofauna of Iran comprises a diverse set of families and species. These form important elements of the aquatic ecosystem and a number of species are of commercial or other significance. The literature on these fishes is widely scattered, both in time and place. Summaries of the morphology and biology of these species were given in a website (www.briancoad.com) which is updated here, while the relevant section of that website is now closed down.

The Catfishes (Order Siluriformes) comprise 35 families and well over 2867 species found world-wide in fresh waters although two families are primarily marine. These fishes date back to the Late Cretaceous. The greatest diversity is found in South America (Nelson 2006). In contrast, Iran has four families with four genera and six species, one of which is an exotic. Their biodiversity in relation to other Iranian fishes is summarised in Coad & Abdoli

(1996) and Coad (1998) and their familial and generic relationships with neighbouring basins in other countries in Coad (1996a).

These fishes range in size from under 10cm to over 3m, one of the largest species, *Silurus glanis*, being found in Iran. They are characterized by a naked body, lacking scales. Some species have armoured plates (but not in Iran). There are 1-4 pairs of barbels around the mouth (one nasal, one maxillary and two on the chin), the maxilla bone is reduced and toothless in many groups and becomes a support for a barbel, eyes are usually small since the barbels are used to find food, the premaxillae bones of the upper jaw usually have teeth, a Weberian apparatus is present (fused and modified 5 anterior vertebrae for transmission of sound from the gas bladder, used as a sounding board to the inner ear), the symplectic, subopercular, basihyal and intermuscular bones are absent, the vomer bone in the roof of the mouth is toothed as are the pterygoid and

palatine bones, the parietal bones are fused to the supraoccipital in the skull roof, the mesopterygoid bone is very reduced, the preopercle and interopercle bones of the gill cover are small, the posttemporal is probably fused to the supracleithrum in the pectoral fin girdle suspension, an adipose fin is usually present, principal caudal fin rays are 18 or fewer (usually 17), the caudal skeleton may have 6 separate hypural plates or be fused into a single element, serrate spines often present at the front of the dorsal and pectoral fins which can be locked erect, there are no pelvic fin spines, and some have an air-breathing apparatus (e.g., Heteropneustidae in Iran).

Catfishes are important food and sport fishes in many parts of the world and smaller species are popular in the aquarium trade. The larger species are significant predators on commercially important fishes. The pectoral fin spines can carry venomous tissue and can cause death in humans. Food comprises a wide range of invertebrates and fishes. Catfishes spawn in open water, build nests to protect the young, or brood eggs in the mouth. Some South American species are parasites on other fishes, taking blood from the gills and skin, and may enter the human urethra causing a unique and distracting pain. South America also harbours electric catfishes which can deliver a numbing shock.

Key to Species

1a. Anal fin very elongate with 60 or more branched rays ==============================> 2
1b. Anal fin short with 10 or less branched rays ===================================> 4
2a. Head small and very flattened, tapering both dorsally and ventrally to terminal mouth; 6-8 branched dorsal fin rays = Heteropneustidae, *Heteropneustes fossilis* - Tigris River basin
2b. Head not as above, mouth superior; 3-5 (usually 3-4) branched dorsal fin rays; Siluridae ====> 3
3a. Teeth short and weak (not snaggly); upper and lower jaws meeting at an anterodorsal position; finely serrate or smooth pectoral spine posteriorly; color dark = *Silurus glanis* - Caspian

Sea, Lake Orumiyeh and Hari River basins
3b. Teeth robust and long (snaggly, catching on flesh); the upper and lower jaws meet at a dorsal and superior position; distinctly and coarsely serrate pectoral fin spine posteriorly; colour light = *Silurus triostegus* - Tigris River basin
4a. No adhesive apparatus on chest = Bagridae, *Mystus pelusius* – Persian Gulf, Hormuz and Tigris River basins
4b. A thoracic adhesive apparatus ("sucker") (Fig. 1) present on the belly between the pectoral fins formed from longitudinal skin folds; Sisoridae ==================================> 5
5a. Head and body dorsolaterally with striated or elongate tubercles; thoracic adhesive apparatus is wider than long, forming a shallow arch; caudal peduncle short (5.9-6.0 in standard length) = *Glyptothorax kurdistanicus* - Tigris River basin
5b. Head and body dorso-laterally without striated or elongate tubercles; thoracic adhesive apparatus longer than wide, forming a deep cleft; caudal peduncle long (4.7-5.4 in standard length) = *Glyptothorax silviae* – Persian Gulf and Tigris River basins.
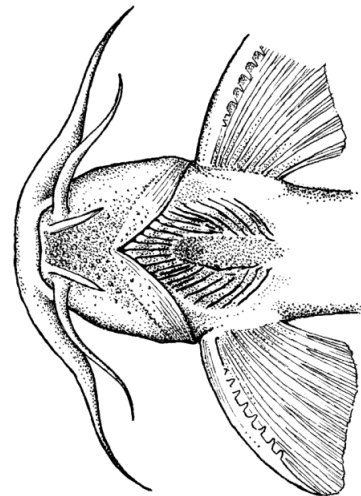
Fig.1. Adhesive apparatus or "sucker" on chest, drawing by C.D. Douglas.

Family Bagridae

The bagrid catfishes are found in fresh waters of Africa and Asia. There are about 20 genera and about

230 species (Jayaram 2006; Nelson 2006; Eschmeyer & Fong 2011). Only one species is known from Iran.

This family is characterised by a scaleless body, a depressed head and rounded to compressed elongate body, short dorsal fin (usually 6-7 branched rays) with a strong, often serrated spine, a pectoral fin with a strong, serrated spine, a short to long adipose fin, anal fin short to long, caudal fin forked or deeply emarginate, a free margin to the gill membranes over the isthmus, the anterior and posterior nostrils are well separated, anterior nostrils tubular, mouth ventral and transverse or arched, 4 pairs of barbels with the nostril barbel on the posterior nostril, maxillary barbels can be very long, other barbels are mandibular and mental (chin), teeth on the prevomer, premaxillaries and mandible, and eyes often covered by skin. Maximum size is about 2m. These catfishes are generally nocturnal. Certain species are important food fishes and others are kept as pets in aquaria.

Genus *Mystus* Scopoli, 1777

This is a catchall genus comprising numerous species in Asia. Roberts (1994) restricts the genus to 8 closely related species (see also Grant (2004). Only one species is known from Southwest Asia including Iran. A history and usage of the name *Mystus* is given by Jayaram and Anuradha (1984).

This genus is characterised by an elongate body, rounded anteriorly and compressed posteriorly, a short and moderately depressed head, head smooth or rugose, an elongate cranial fontanelle extending posteriorly to the base of the occipital process and divided into anterior and posterior portions of nearly equal length by an epiphyseal bar (Roberts 1994), small to moderate eyes set high and not visible from the ventral surface of the head, a free circular eyelid, a wide transverse, usually subterminal mouth, maxillary barbels very long, jaw teeth are in villiform patches, on the lower jaw as a curved or angular band interrupted at the mid-point, continuous and curved slightly in the upper jaw, total gill rakers 11-30, gill openings very wide and free from the isthmus, adipose fin high and very long, caudal fin deeply
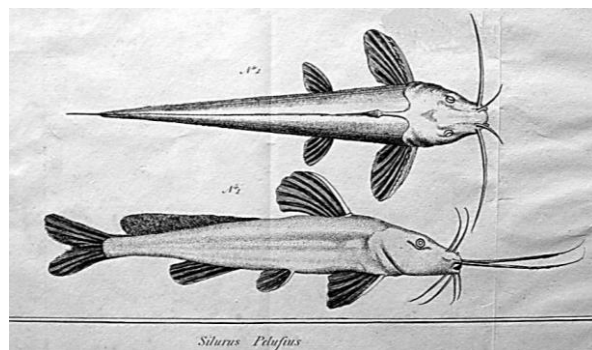
forked, upper caudal lobe often much larger than lower, 37-46 vertebrae about equally divided between abdominal and caudal ones, and branchiostegal rays 6-12.

Mystus pelusius (Solander, 1794)
(Figs. 2-4)
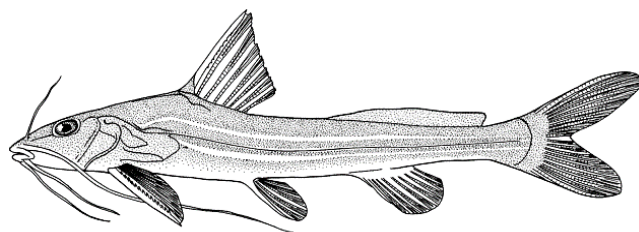
Fig.2. Line drawing of *Mystus pelusius* by S. Laurie-Bourque.

Fig.3. *Mystus pelusius* from Russell (1794), scan from original in possession of B.W. Coad.

Common names: Abu-zummair or abu zumir (an Arabic name used in Khuzestan); mahi nish dor (an Abadani name, from www.abadan.net/ abadanidictionary.html, accessed 4 December 2003); sag mahi (= dog fish); gorbeh mahi (= catfish); chamu. [abu-zummair, abouz-zoumeir, abu-al-zamir, abu'l-zoumeir, abu al-zummayr al-'amiq; zugzug in Aleppo; jahudi (= Jewish, after Mikaili & Shayegh (2011) in Mosul, all in Arabic; Tigris mystus (Fricke et al. 2007)].

Systematics: Synonyms are *Bagrus halepensis* Valenciennes in Cuvier and Valenciennes, 1840 from the "Couiac, qui est la rivière d'Alep" (= Quwayq River at Aleppo, Syria) (see Bailey (1951) on the publication date), *Macrones aleppensis* Günther, 1864, *Macrones colvillii* Günther, 1874 from

Fig.4. Freshly-caught *Mystus pelusius* from Khuzestan, courtesy of A. Afzali.

"Bagdad", and *Mystus misrai* Anuradha, 1986 described from "Lake Antioche, Syria". *Hypselobagrus Aleppensis* is a new combination by Lortet (1883). Günther (1864) proposed *Macrones aleppensis* on page 75 but withdrew the name on page 431 when he realised the species was the *Silurus pelusius* of Solander. No types of *Silurus pelusius* described from the "River Kowick" (= Quwayq) are known (Eschmeyer et al. 1996). A syntype of *Macrones aleppensis*, 127.8mm standard length, from the "R. Coic, Aleppo, Syria" is in the Natural History Museum, London (BM(NH) 1955.6.25:1) (also listed as a possible syntype of *Silurus pelusius* by Eschmeyer's Catalog of Fishes, accessed 26 November 2014). Six syntypes of *Macrones colvillii* are also in London, ca. 175-234mm standard length, from "R. Tigris nr. Baghdad" collected by Colville (BM(NH) 1874.4.28:6-8, 1875.1.14:19-21; Roberts

(1994) agrees with my observations although Eschmeyer et al. (1996) give BM(NH) 1875.1.14:19-20 for the latter, i.e., 2 fish only, corrected in Eschmeyer's Catalog of Fishes, accessed 26 November 2014).

No types of *Bagrus halepensis* are known. The holotype of *Mystus misrai* is in the Muséum d'Histoire Naturelle, Geneva under MHNG 603.95, measuring 123.1mm standard length, with 1 paratype under MHNG 2231.84 measuring 117.6mm standard length, 1 paratype in the Zoological Survey of India, Calcutta under FF2315 and 1 specimen missing (Eschmeyer et al. 1996).

Roberts (1994) indicates that more material should be examined to compare fish with short barbels, weakly serrate dorsal spine, short adipose fin and a highland distribution (= *pelusius*) while the contrasting fish are *colvillii*.

Key characters: The 4 pairs of barbels, a strong spine in both the dorsal and pectoral fins, elongate and strong adipose fin are distinctive. The head tapers but is not as flattened as in *Heteropneustes fossilis*, and the mouth is subterminal.

Morphology: The dorsal fin spine is smooth on most of the outer edge and rough on the inner edge. Serrae can be weakly developed or absent, or may be well-developed. The dorsal fin spine has 1-4 serrae or notches at the anterior tip and 5-9 along the rear margin, apparently not related to fish size. The pectoral spine is stronger than the dorsal spine and is serrated with 14-23 antrorse teeth on the inner margin, the number increasing with size. The maxillary barbel extends back to the pectoral fin origin or, rarely, as far as beyond the anal fin.

Dorsal fin with 1-2 spines and 7-8, usually 7, branched rays, anal fin with 6-10 branched rays, pectoral fin with 1 spine and 7-9 branched rays and the pelvic fin with 5-6, usually 5, branched rays. Al-Hassan and Hassan (1994) have shown asymmetry in pectoral ray and gill raker counts in samples of this species from the Shatt al Arab, Iraq, possibly due to environmental stress. Total gill rakers 10-18 (Roberts (1994) gives 12(1), 13(7), 14(11), 15(11), 16(8),

17(4) and 18(1)), reaching the second raker or further when appressed. Total vertebrae 42-46 (Roberts (1994) gives 42(10), 43(16), 44(3), 45(2) and 46(5). The gut has a large stomach followed by an intestine with about 4 loops.

In specimens examined by me, dorsal fin with 2(11) spines and 6(1) or 7(12) branched rays, anal fin with rays difficult to separate into branched and unbranched (perhaps 4-6 unbranched and 6-10 branched rays), pectoral fin with 1(11) spine and 7(3), 8(6), 9(3) branched rays and the pelvic fin with 5(13) branched rays. Total gill rakers 12(1), 13(2), 14(3), 16(3). One specimen with only 7 gill rakers, was possibly abnormal. Total vertebrae number 42(1), 43(1), 44(2) and 45(1).

Sexual dimorphism: Unknown.

Colour: Pale brown to olivaceous overall with fins and belly lighter, on a predominant dark silver. Some fish may be silvery-grey overall when fresh. A dark shoulder spot is present. There may be a black spot at the base of the dorsal fin. The dorsal and anal fins have melanophores on the rays and membranes and so are darker than the other fins. The margin of the adipose fin is narrowly black. The caudal fin has a black margin. There may be 3 (sometimes 2), narrow, white stripes on the flank, one along and one each above and below the lateral line. The stripe below the dorsal and adipose fins is narrower than the others. Barbels are whitish, somewhat darker dorsally. Peritoneum silvery to light brown. Jayaram and Sanyal (2003) report an albino specimen from Baghdad.

Size: Reaches 171.2mm standard length or 22.9cm total length (Günther 1874), but possibly to 30.0cm total length (Firouz 2000, 2005) or 33.0cm (Al-Rudainy 2008).

Distribution: Found in the Orontes (= Asi), Quwayq, and Tigris-Euphrates basins. In Iran this fish is found in such rivers as the Arvand, Bahmanshir, Karun (Fig. 5), Karkheh, Gav Masiab, Jarrahi and Zohreh rivers (Najafpour 1997; Eskandary et al. 1999; Abdoli 2000). Also recorded from Fars near Darab in the Rudbal River drainage, which flows to the Straits of Hormuz, possibly an accidental introduction, although Esmaeili & Coad (2005) point out that there is no evidence of fish introductions from Khuzestan to Fars. It may simply be very rare outside the Tigris basin in Iran.

Zoogeography: Jayaram & Sanyal (2003) consider that *Mystus* is derived from an African *Bagrus*-like ancestor and the genus spread from west to east.

Habitat: Niazi (1976) observed this species in rivers, marshes and brackish waters in Iraq although summer kill resulted from very low water levels and increased salinity.
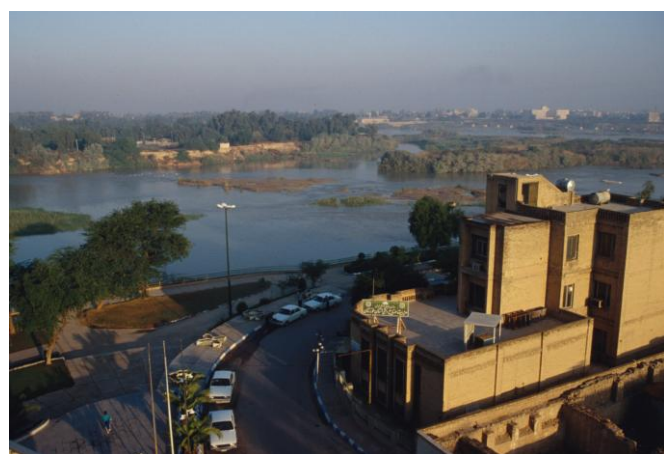
Fig.5. Karun River at Ahvaz, 21 November 2000, habitat of *Mystus pelusius*, B.W. Coad.

Age and growth: Al-Hassan et al. (1991) aged this species using eye lenses and vertebrae for a population from the Qarmat Ali River north of Basrah, Iraq. Fish up to 20cm total length were examined and three age groups were determined, with considerable overlap of lengths for each group. Al-Shami (1998) however found 7 age groups (0^+-6^+) for the same river using vertebrae to age fish 54-223mm total length. The highest growth was found in the first year and no significant differences were found between males and females in growth rate. The L_∞ was 225.75mm and the length-weight relationship log W=-4.7516+2.8173 logL. The relative condition ranged from 0.94 in December to 1.22 in May. Heydarnejad (2009) gave the length-weight relationship for an Iranian sample as W=0.0277TL2.999.

Food: Roberts (1994) found eggs in the branchial chamber and stomach apparently identical with those from the ovary. Other stomach items were fish fin pieces and cyprinid fish scales. Aquatic insects, crustaceans, detritus and plant remains are also found in stomach contents of fish examined by me and Al-Rudainy (2008) also mentions fish. Al-Shami (1998) found mean feeding activity and intensity in the Qarmat Ali River, Iraq to be higher in spring and summer, declining in autumn and winter. This fish was carnivorous, taking mainly crustaceans but also insects, fishes, molluscs and aquatic plants. Hussein and Al-Shami (2001) also reported that fish in the Garma Canal, Iraq had a diet dominated by crustaceans (the isopod *Sphaeroma annandalei*, amphipods, the decapod *Elamenopsis kempi*, and the prawns *Metapenaeus affinis* and *Atyaephyra desmaresti*), followed by aquatic insects (chironomids, corixids and dytiscids), fish (*Alburnus* sp. and *Aphanius dispar*), molluscs (the gastropod *Lymnaea tenera euphratica*) and aquatic plants. Feeding occurred year round with a peak in May and a lowest value in November. Al-Shamma'a (2005) found shrimp and insects to form 47% by volume of the diet of this fish at Al-Fuhoud, Hawr al Hammar, Iraq.

Reproduction: The Qarmat Ali River fish attained maturity in the first year of life with the smallest mature male 92mm long and the smallest female 72mm. Eggs were laid in May and June with a fecundity range of 1156-25,833 eggs for fish 105-180mm total length and 11.88-49.29g in weight. Relative fecundity was 97.3-524.1 eggs/g (Al-Shami 1998). Al-Rudainy (2008) gives a relative fecundity of up to 541 eggs/g in Iraq.

Parasites and predators: None reported.

Economic importance: This species is of no economic importance. Anglers may catch it on hook and line in Khuzestan, e.g., at Ahwaz but, being scaleless, it is not eaten.

Conservation: This species appears to be relatively common, although not often caught in large numbers. Listed as Least Concern by the IUCN (2013)

(accessed 26 November 2014).

Sources: Description also based on Anuradha & Jayaram (1985) and Anuradha (1986). Further details on collections examined can be found in the museum catalogues.

Type material: See above under *Macrones aleppensis* (BM(NH) 1955.6.25:1) and *Macrones colvillii* (BM(NH) 1874.4.28:6-8, 1875.1.14:19-21).

Iranian material: CMNFI 1979-0087, 1, 162.2mm standard length, Khuzestan, Karun River at Ahvaz (31º19'N, 48º42'E); CMNFI 1979-0368, 1, 75.6mm standard length, Khuzestan, Karkheh River (32º24'30"N, 48º09'E); CMNFI 1991-0153, 1, 123.3mm standard length, Khuzestan, Zohreh River (no other locality data); CMNFI 1993-0133, 1, 152.6mm standard length, Khuzestan (no other locality data); CMNFI 2008-0132, 1, 193.4mm standard length, Khuzestan (no other locality data); CMNFI 2008-0151, 1, 144.7mm standard length, Kermanshah, Gav Masiab River (34º10'44"N, 47º20'48"E); BM(NH) 1905.10.14:57, 1, 140.1mm standard length, Bushehr, Jarrahi River 140 miles northwest of Bushehr (no other locality data); ZMH 2524, 1, 137.1mm standard length, Kermanshah, Karasu-Gamasiab-Seymarreh (no other locality data); ZMH 4339, 2, 100.5-100.6mm standard length, Khuzestan, Karun River (no other locality data); uncatalogued material, 1, 57.7mm standard length, Fars, Cheshmeh Golabi, 15km west of Darab (28º47'N, 54º22'E) (Esmaeili and Coad 2005).

Comparative material: CMNFI 1980-1036, 2, 161.0-167.8mm standard length, Turkey, Elazig, Keban Dam near Elazig (38º41'N, 39º14'E); CMNFI 1987-0017, 1, 156.8mm standard length, Iraq, Hawr al Hammar (no other locality data); BM(NH) 1912.5.2:7, 1, 172.5mm standard length, Iraq, Shatt al Arab (no other locality data); BM(NH) 1920.3.5:5-6, 2, 95.4-101.0mm standard length, Iraq, Basra (30º30'N, 47º47'E); BM(NH) 1936.3.10:3, 1, 56.1mm standard length, Iraq, Euphrates River at Nasiriyah (31º02'N, 46º16'E); BM(NH) 1974.2.22:1781-2, 1, 52.3mm standard length, Iraq, Khalis (33º49'N, 44º32'E); BM(NH)

1974.2.22:1783-4, 1, 31.0mm standard length, Iraq, Khalis (33º49'N, 44º32'E); BM(NH) 1975.5.16:6, 1, 155.2mm standard length, Turkey, Elazig, Euphrates River, Keban Dam Lake (no other locality data).

Family Heteropneustidae

The stinging or airsac catfishes comprise a single genus with four species found naturally from Pakistan through India to Thailand (Eschmeyer & Fong 2011). The family is characterised by an elongate and compressed body with a flattened head, the mouth is small and transverse with fleshy, papillated lips, villiform teeth present on the jaws and vomer, 4 pairs of barbels present (nasal, maxillary and 2 mandibular), the anterior nostril is tubular and the posterior nostril a slit, gill openings wide and gill membranes free from the isthmus, air sacs are present (see below under Morphology), gas bladder very small, the dorsal fin is short and spineless, no evident adipose fin (a low ridge may be present), very long anal fin confluent with the caudal or separated from it by a notch, pectoral fin with a strong and venomous spine, and branchiostegal rays 7. These fishes can live in stagnant water by breathing air. They are dangerous to man since the pectoral spine harbours strong venom. Stinging catfishes nonetheless are an important food in their native range.

Genus *Heteropneustes* Müller, 1840

The only genus in the family, its characters are given above.

Common names: Eshlambo or abu shalambo (note variants on this word are used for catfishes and mudskippers); dudeh, doodeh or dood in Khuzestan (= smoke, perhaps because it is blackish, or from the Arabic for worm after Mikaili & Shayegh (2011)); bu shalambo in Khuzestan; gorbeh mahi-e nishzan; gorbeh mahi hendi, meaning Indian catfish. [samaka or samakah (= little fish, from Mikaili & Shayegh (2011), abu-al-hukum, abu al-hakim, abu-alhaka, samma, samaka samma, djirri lasseye or jamhoori (latter at Baghdad in reference to the then new republic or jamhooria (F. Kedairy, *in litt.* 21

December 2005)), samak al-za'em (named after a former president who had this species introduced for mosquito control), all in Arabic; singhi in Pakistan; Indian stinging catfish].

Heteropneustes fossilis (Bloch, 1794)
(Fig. 6)
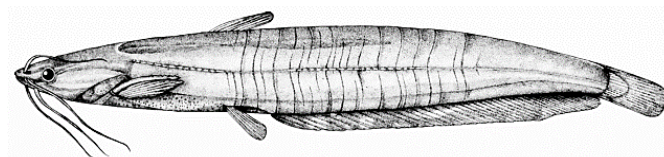
Fig.6. Line drawing of *Heteropneustes fossilis* by S. Laurie-Bourque.

Systematics: Silurus fossilis was originally described from Tranquebar, Tamil Nadu, India. A syntype of this species is in the Museum für Naturkunde, Universität Humboldt, Berlin under ZMB 3074 (Eschmeyer et al. 1996). Ratmuangkhwang et al. (2014) demonstrated that three clades are present in southeast Asia and northeastern and southwestern India that may potentially be separate species. The source of the exotic population in Iran is not known but molecular evidence would help determine the area of origin in Asia.

Key characters: The 4 pairs of barbels, short and spineless dorsal fin, absence of an adipose fin, and the long anal fin are distinctive. The head is small and very flattened and tapers both dorsally and ventrally to a terminal mouth.

Morphology: There are two, tubular air sacs extending from the gill cavity almost to the caudal peduncle, enabling this catfish to breathe air. On capture, air from these sacs may escape and cause a peculiar squawking sound. The anatomy and function of these organs was reviewed by Datta Munshi (1993).

Dorsal fin with 6-8 rays but no spine, anal fin rays 60-79, pectoral fin branched rays 7-8 after a strong spine serrated on its inner margin, and pelvic fin branched rays 5-6. Fin rays are difficult to count without dissection or x-rays because of the fleshy and heavily pigmented nature of the fins. Iranian

specimens generally fall within the ranges cited above from literature sources as far as can be determined. Spine serrations are more notch-like than toothed. Al-Hassan et al. (1990) have demonstrated that the level of asymmetry in pectoral fin ray and total gill raker counts increases with fish length. Gill rakers are elongate, reaching adjacent raker 5-7 when appressed and number about 25. Barbels are elongate, the snout barbel being the shortest at about head length, the inner mandibular barbel being head length or longer, and the mouth corner and outer mandibular barbel being much longer than the head. The gut is elongate with several posterior coils.

Zakaria (1964) gives details of the pectoral fin spine anatomy. Singhkohli & Goswami (1987) and Kaul & Rishi (1987) describe abnormalities in this species including an upturned tail, a forked tail and forked barbels.

Sexual dimorphism: Unknown.

Colour: Overall colour is yellow or leaden to dark green, grey-brown, rust-brown or even black, occasionally with two yellowish stripes. The flanks may also be spotted. The barbels are darker than the adjacent body. The eye is yellow. Young specimens are reddish and have a pale belly with numerous melanophores.

Size: Males reach 24.2cm, females 34.4cm in India (Datta Munshi and Choudhary 1996). Fish up to 25.0cm are recorded from the recovering southern Iraqi marshes (Hussain et al. 2006).

Distribution: First recorded from Iraq for 1960 by Khalaf (1961) and Zakaria (1964) when a strange fish was reported to have inflicted a "painful bite" on several victims. The species spread northward and also eastward into Iran from southern Iraq. One collection from Dezful (see below) is dated February 1960 so the spread into Iran must have been very rapid or the original Iraqi introduction some years earlier than documented. It is now known from the Turkish Tigris River near Diyarbakır, presumably dispersing upstream from southern Iraq (Ünlü et al. 2011). Found from Turkey and Iraq eastward but not continuously across Iran, through South Asia to Vietnam. It is common in rivers and marshes of Khuzestan including the Dasht-e Azadegan and Shadegan Marsh, and the Arvand, Bahmanshir, Dez, Shavor, Karkheh, Karun and Jarrahi rivers (Coad & Abdoli 1993; Najafpour 1997; Eskandary et al. 1999; Abdoli 2000; Coad 1996b, 1996c). Berra (2001) omits their Middle Eastern distribution as they are thought to be introduced.

Zoogeography: An Iraqi biologist told me that this species was introduced to Iraq for mosquito control (*sic*) by local authorities although no one would later admit to it. A more reasonable assumption is that it was introduced to eat the snail *Bulinus truncatus*, a vector for the human parasite causing schistosomiasis. It was ineffective in this regard (L.A.J. Al-Hassan, *in litt.* 1995; Jawad 2003) and eradicated *Barbus* (= *Arabibarbus*) *grypus* eggs along the Tigris (F. Kedairy, in litt. 21 December 2005). There has probably been no natural, large scale migration from Pakistan as envisaged by Banister & Clarke (1977) and Banister (1980). Some Sumerian names may refer to this species but this is by no means certain (Sahrhage 1999).

Habitat: It is common in rivers, marshes, ponds and canals and is found in both fresh and slightly brackish waters. Al-Daham & Bhatti (1977) found this species to suffer 25% mortality over 72 hours at 10.25‰ sea water and Al-Hassan & Muhsin (1986) noted moribund fish in the saline Khor al Zubair, Iraq (annual temperature range 12-30°C and annual salinity change 28-47‰). It was most abundant in polluted and stagnant areas in the lower Diyala River where it dominated catches or was the only fish present (Khalaf et al. 1987; Biro et al. 1988). It is common in swamps and can survive temperatures up to 39.8°C (Pethiyagoda 1991). Specimens survived 3-6 hours in air. It air breathes every 3-5 minutes but the frequency varies with time of day and weather conditions. On hot and calm days it visits the surface more frequently than during a heavy shower. S. Cowton (pers. comm. 23 August 2005) has observed schools of this species gaping at the surface in the artificial lake around Al Faw Palace in Baghdad,

presumably in response to high temperatures and low oxygen. Individuals were also seen rapidly swimming straight up to the surface, gulping and diving straight back down again. On especially sultry days it may float or swim near the surface. In the dry season of India it can live in semi-liquid mud or at the bottom of fissures where the mud has cracked (Jayaram 1980). It makes nest holes in the sides of ponds about 1 foot below the water surface in the form of anastomosing tubes with several exits. Up to 364 fish can be found in one complex of holes (Datta Munshi & Choudhary 1996). Tekriwal & Rao (1999) report its aquarium preferences and habits as 22-25°C, pH 7.5-8.5, alkaline water, predator, not too bright lighting, bottom dwelling with stones, roots and crevices preferred and cave brooding reproduction. Zakaria (1964) noted aquarium specimens producing audible squeaks when excited and preferred the darker side of an aquarium.

Age and growth: Khalaf et al. (1987) gave length-weight relationships for Diyala River, Iraq fish in autumn as $W=9.12 L2.95$ (r=0.98, n=58) and in spring $W=0.11 L2.15$ (r=0.84, n=66) and condition factor was 0.0012 in autumn and 0.08 in spring. Islam et al. (1982) give the following length-weight relationships for fish from the Ashar Canal, Basrah, Iraq: $\log W=-6.35211+3.53226 \log TL$ (r=0.93543), $\log W=-5.96765+3.42353 \log SL$ (r=0.93687), and $\log W=-1.35223+2.04705 \log GL$ (r=0.87876) (TL=total length, SL=standard length, GL=girth length). Tabrez Nasar (1993) studied populations in India and gives length-weight relationships, $\log W=1.7661+3.035 \log L$ for one population and $\log W=1.805+2.615 \log L$ for another. The coefficient of condition varied from 1.582 to 2.151, mean 1.89. A pond population did not grow as well as a natural one. Life span was up to 4 years in Iraq at Qarmat Ali using ocular lens diameter and vertebral rings (Al-Hassan et al. 1992) and may be 4^+ years in India (Datta Munshi and Choudhary 1996).

Food: Al-Daham et al. (1977) studied the diel feeding of this species in the Ashar Canal, Basrah, Iraq. Two feeding peaks were observed - at 0500 hours and

1700 hours, dawn and dusk, but stomachs examined around the clock had food in them. Aquatic plants and detritus are the bulk of the diet, followed by entomostracans and aquatic insect larvae. Also present are fish parts, molluscs and non-aquatic organisms. Cannibalism is reported in India for young fish (Jayaram 1980). Khalaf et al. (1987) studied this species in the Diyala River, Iraq and found young fish to take chironomids and worms while larger ones ate fish. However all sizes take aquatic insects in spring. There is some competition with *Barbus* (= *Mesopotamichthys*) *sharpeyi*, a commercial species (Jawad 2003). In a study of the recovering Hawr al Hammar, diet was 47.2% insects, 22.1% shrimps and 20.8% fish, in the Hawr al Hawizah 33.9% shrimps, 25.8% fish, 20.8% insects and 19.2% snails and in the Al Kaba'ish (= Chabaish) Marsh 51.2% shrimps, 26.4% fish, 12.0% insects and 10.4% snails (Hussain et al. 2006).

Chili, macaroni, corned beef casserole, mixed vegetables and salad are dietary items at Camp Liberty, a former palace in Baghdad, where American soldiers fed leftovers from a distinguished visitors dining hall to catfishes, apparently this species (www.estripes.com, accessed 7 September 2006). Small Iranian specimens contained insects in their guts including Notonectidae and Diptera larvae. Abdoli (2000) lists diatoms, Chlorophyceae, fish remains, Corixidae, Hemiptera, cyclopoid Copepoda, termites, Isopoda, Chironomidae, Oligochaeta and Rotifera.

Reproduction: Sexual maturity in India is reached when fish are about 1 year old, at 8.5cm for males and 12.0cm for females. Fecundity reaches 12,000 eggs (Haniffa et al. 2008a). Al-Rudainy (2008) reported sexual maturity at 2-3 years, 12cm length and 40g weight in Iraq. Spawning there took place continuously from June to August with eggs deposited in batches on vegetation. Females take care of the fry.

Eggs are laid in a shallow depression excavated by both the male and female in mud or sand. Eggs are light green. They hatch in about 2 days in Sri Lanka.

The parents guard the eggs and young until the young fish are about a month old and able to look after themselves. Singh Kohli & Goswami (1987) describe spawning behaviour in aquaria after hypophysation using pituitary glands of Indian major carps. A pair of males circled each other in a figure 8 pattern until one established dominance. The dominant male chased the female, swimming underneath her or obstructing her path, and touching barbels. The male tried to bite the female in the chases and shivered its whole body while making lateral passes. The male arcs its body into a u-shape, the female touches the male's genital papilla and the pair remain motionless for 2-5 seconds. The female jerks and separates from the male releasing the eggs which settle to the bottom. The pair rest before mating again. About 40-200 eggs are released after each mating. Mating acts number 20-100 and always occur near the surface of the aquarium. Spawning is more complete and egg fertilization is better when there is one female and two males, the other male acting as a stimulator, with the spawning male quarrelling with the non-spawning male between mating with the female. Datta Munshi & Choudhary (1996) report similar behaviour. The male nudges the genital region of the female with his head, occasionally shaking it from side to side. Eventually the female is aroused and nudges the male genital region. This female action was necessary for mating to occur. Mating did not happen when spawners were of different sizes. Once the female has her snout below the male genitalia, the male twists his body to place his snout below her genitalia. The fish remain motionless for 2 seconds, then the male vibrates his body and the female convulses and releases eggs. This can happen 30-50 times for each couple at 2-3 minute and then later 5-10 minutes or longer intervals. About 100-150 eggs are extruded, the number decreasing over time. If more than one male is present, mating only occurs after one establishes dominance. Males may eat eggs. Spawners mate in the water column or near the surface.

Parasites and predator: Jalali et al. (2005) summarise the occurrence of *Gyrodactylus* species in Iran and record *G. fossilis* in fish from the Karun River.

Economic importance: An important food fish in India and Sri Lanka, where its flesh is reported to have invigorating qualities. Some fish are exported from Sri Lanka for the aquarium trade. V. D. Vladykov reported (*in litt.* 22 July 1963) that he had seen this species in pet shops in Tehran, on sale at about $2.00 each. The pectoral spine can cause a serious wound because of the toxin content of the epidermal cells covering the spine. The histology of the pectoral spines was described by Bhimachar (1944) based on Indian material and the toxin was found to have both neurotoxic and haemolytic effects. The toxin is fatal to frogs (within 15-20 minutes of subcutaneous injection of glycerinated venom) and to other fishes.

Zakaria (1964) reported severe swelling involving the whole arm from a hand sting in Iraq. The swelling and pain recede after about a day but the puncture wound can take about two weeks to heal and some pain can be felt when applying pressure to the wound site up to six weeks later. Caras (1964) (probably based on a report in Farsi in *Game and Nature*, Tehran, ca. 1961) recorded a diminutive black fish found in the Shatt al Arab which reputedly killed 28 people with a venomous *bite* (*sic*). Death was said to be swift. This was presumably a garbled report on this species. Verbal and newspaper reports from Tehran (V. D. Vladykov, *in litt.* 26 August 1961) maintain that this species could cause death to cattle and humans although Vladykov (*in litt.* 30 September 1963) considered fatal cases "not well proved". I was stung in the thumb by this fish in Iran with no effect (although I did devote considerable time and effort into squeezing and sucking blood from the puncture site!). Freshly caught or netted fish swing the head from side to side and thus are active envenomators (despite knowing this I was still stung). Treatment is symptomatic and some relief can be obtained by immersing the sting site in water as hot as can be withstood and applying a meat tenderiser. These treatments serve to coagulate the

protein toxin. The wound should be cleaned to avoid secondary infections such as tetanus (Halstead 1967-1970; Coad 1979).

Dorooshi (2012) reports on two envenomations by catfish referred to the poison center of Noor Hospital, Isfahan University of Medical Sciences. The catfish were aquarium specimens and their identity was not specifically stated but it was implied that they were *Heteropneustes fossilis*. The stings were on the hands, causing swelling and pain. Immersion in hot water (temperature 45°C) led to a gradual reduction and elimination of pain in less than half an hour.

R. Beck (pers. comm. 2000) reports that this fish is now present in the Syrian Euphrates, its tributaries, and in irrigation canals. Incredible numbers occur near town sewage outlets and in weed beds. It is known to consume eggs of *Arabibarbus grypus*, a preferred food species

Robins et al. (1991) list this species as important to North Americans. Importance is based on its use in aquaculture, as food, in textbooks and because of its venomous nature.

Conservation: This is an exotic species and requires no conservation although it is listed as Vulnerable in its natural habitats (Haniffa et al. 2008a, 2008b). The numbers of this species in Iraq appear to be in decline (Hussein 2000; N. A. Hussain, pers. comm. 2005). Numbers around Baghdad 30 years ago were so high that "you could not swim without being stung by one. Rather painful" (F. Kedairy, *in litt.* 21 December 2005).

The distribution of this species should be mapped in detail as it is potentially hazardous to humans.

Sources: Further details on collections examined can be found in the museum catalogues.

Iranian material: CMNFI 1979-0087, 1, 189.0mm standard length, Khuzestan, Karun River at Ahvaz (31°19'N, 48°42'E), CMNFI 1979-0359, 5, 96.9-114.2mm standard length, Khuzestan, Karkheh River at Hamidiyeh (31°29'N, 48°26'E); CMNFI 1980-0909, 4, 113.2-165.0mm standard length, Khuzestan

(no other locality data); CMNFI 1993-0133, 1, 237.7mm standard length, Khuzestan (no other locality data); CMNFI 2008-0132, 1, 136.6mm standard length, Khuzestan (no other locality data); BM(NH) 1980.8.28:4-5, 2, 91.7-98.0mm standard length, Khuzestan, Dezful (32°23'N, 48°24'E); ZSM 27369, 3, 111.9-139.0mm standard length, Khuzestan, Karun River near Ahvaz (ca. 31°19'N, ca. 48°42'E).

Comparative material: BM(NH) 1962.7.26:80-83, 4, 127.8-189.0mm standard length, Iraq, Baghdad (33°21'N, 44°25'E); BM(NH) 1974.2.22:1785, 1, 89.8mm standard length, Iraq (no other locality data); BM(NH) 1974.2.22:1786-1788, 3, 102.3-165.3mm standard length, Iraq (no other locality data); ZSM 19455-56, 2, 123.2-127.7mm standard length, Iraq, Tigris River near Amara (ca. 31°43'N, ca. 47°06'E).

Family Siluridae

The sheatfishes are found in Europe and Asia. There are about 12 genera and about 99 species (Nelson 2006; Eschmeyer & Fong 2011) with 2 reported from Iran. The phylogenetic relationships within the family are examined by Bornbusch (1995).

This family is characterised by a large, scaleless and elongate body, a moderately compressed head, a non-protractile mouth, depressible teeth on the jaws and palate, 1-4 pairs of barbels (nasal barbels usually absent, maxillary barbels 1-2 pairs, sometimes vestigial or absent), nostrils separate, anterior ones tubular, 4-21 branchiostegal rays, gill openings very wide, dorsal fin short and spineless (usually fewer than 7 rays and sometimes absent), anal fin very long (41-110 rays) and may be confluent with the caudal fin, adipose fin absent, pectoral fin with a spine, often serrated, and pelvic fins small to absent. The largest species is found in Iran (*Silurus glanis*).

Genus *Silurus* Linnaeus, 1758

These catfishes comprise about 5 species found from Europe to China and India. This genus is characterised by an elongate body, rounded anteriorly but compressed posteriorly, a depressed

head, 2-3 pairs of barbels, the maxillary barbels well-developed and often as long as, or longer than, the head, a large and terminal or superior mouth, teeth in bands on the jaws and roof of the mouth, nostrils well separated, eyes small and not visible from the underside of the head, a very short and spineless dorsal fin, no adipose fin, anal fin very long and united to the rounded caudal fin, pectoral fin with a strong serrated spine, and branchiostegal rays 12-15. The genus has been revised by Kobayakawa (1989).

Krieg et al. (1999) isolated microsatellite loci in both *S. glanis* and *S. triostegus* and found that the species diverged less than 20MYA and/or had high levels of genomic conservation. Krieg et al. (2000) investigated mitochondrial DNA in *S. glanis* but found no consistent pattern of geographic structuring in European populations, evidence that gene flow and migration between populations were possible until quite recently. Their study also included *S. triostegus* and the data was diagnostic for the two species. A general Farsi name for these fishes is gorbeh mahi (= cat fish).

Silurus glanis Linnaeus, 1758
(Figs. 7-11)
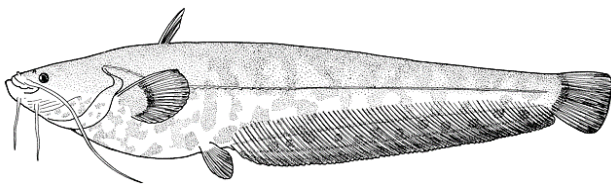
Fig.7. Line drawing of *Silurus glanis* by S. Laurie-Bourque.

Common names: Mahi-e sebili, esbele or esbeleh in Gilaki (probably derived from sibil meaning moustache in reference to the barbels), esbele-ye orupaiye, Urupai or Europaiye; ispek (Floor 2003), gorbeh mahi rogahee, nake or naque in the Lake Orumiyeh basin, where they are known as "whales". [lakha mahi in Afghanistan; naxa, nagka or nakki in Azerbaijan; loko in Armenia; som in Russian; European catfish, sheatfish, wels, wels catfish, Danube catfish].

Systematics: *Silurus glanis* was originally described

Fig.8. Aras River Dam, courtesy of Asghar Abdoli (measuring fish) 2.25m, ca. 90kg, 5 October 1994.

Fig.9. *Silurus glanis*, Safid River, 2km west of Astaneh, 4 June 1978, caught in a large dip-net (see below), Brian W. Coad.

from lakes of Europe, Sweden. A skin is a syntype in the Natural History Museum, London under BM(NH) 1853.11.12:168 (Eschmeyer et al. 1996). An image of this type is available at http://acsi.acnatsci.org/base/image_show_wrapper.html?target=230943. *Silurus chantrei* Sauvage, 1882 is possibly a synonym (see under *Silurus triostegus*). **Key characters:** This species differs from *S. triostegus* by having weaker and shorter teeth, the upper and lower jaws meet at an anterodorsal position (dorsal and superior position in *S. triostegus*), a less serrate pectoral fin spine posteriorly, and a darker colour. Maxillary barbel length is much longer on average, although there is some overlap. Anterior mandibular barbels are always longer than posterior mandibular barbels

Fig.10. *Silurus glanis* catch, Aras Reservoir, March 2012, courtesy of K. Abbasi.

Fig.11. *Silurus glanis* catch, Anzali, courtesy of K. Abbasi.

while in *S. triostegus* the posterior mandibular barbels are always longer (Ünlü & Bozkurt 1996).

Morphology: The lower jaw is longer than the upper. Adults have one pair of maxillary barbels and two pairs of mandibular barbels, for a total of 6 barbels. The maxillary barbel is much longer than the head (equal to head length in *Silurus triostegus*). The pectoral fin spine is finely serrated or smooth on its inner surface and smooth on its outer surface. Vomerine teeth form a single broad patch, not two as in *S. triostegus* (Kobayakawa 1989).

Dorsal fin branched rays 3-5, usually 4, anal fin branched rays 65-108, pectoral rays 12-18 with 1 spine (generally higher on average than in *S. triostegus* but still overlapping), and pelvic rays 1 unbranched followed by 9-14 branched rays (Coad and Holčík 2000; Reshetnikov 2002). Vertebrae 70-76 and total gill rakers 9-17 (counts of 9 and 10 may be lower arch rakers only). Total vertebrae number 67-74. In specimens examined by me dorsal fin branched rays 3-4, anal fin branched rays 83-87, pectoral rays 15-16 with 1 spine, and pelvic rays 1 unbranched followed by 11-12 branched rays. Vertebrae 18-19+54-56=72-74. Total gill rakers 12, reaching the raker below when appressed. The gut has a large stomach and an intestine with about 3 loops. Chromosome number is 2n=60 (Ráb et al. 1994; Klinkhardt et al. 1995).

Sexual dimorphism: Abdurakhmanov (1962) reports that females have longer maxillary barbels, a longer postorbital length and a greater caudal peduncle depth than males in Azerbaijan.

Colour: The body is mottled with brown, green or dark grey, even ventrally, over the base colour. The back is dark, from olive-brown to a blue-black, the sides lighter and the belly greyish-white with bluish speckles. Fins are a dark red-brown to brown-violet. Paired fins have a yellowish streak in the middle. The iris is yellowish with black speckles. This species can blend its colour with any bottom on which it lies in wait for prey (Fortunatova 1961).

Size: Reaches legendary sizes of 5.5m and 367kg (and possibly over 500kg) but most are much smaller (Machacek (1983-2012), accessed 27 July 2012). In the Volga Delta females reach 1.75m and 31kg and males 1.95m and 41kg (Orlova 1988); in Dagestan specimens up to 1.93m and 41.3kg are recorded although fish weighing 3.2-4.8kg predominate (Shikhshabekov 1978).

In the Caspian Sea commercial fishery of Iran, this species ranges in size from 41 to 186cm and 0.6 to 42kg (Farid-Pak no date). Sohrabi (1996) reports the larger fish in Iranian waters usually weigh 10-40kg and depicts two fish from Gilan. One caught in

1995 weighed 27kg, the other caught in 1994 weighed 62kg. The record fish from Iran, caught by a Mr. Haratonian weighed 120kg and was 2.2m long. Eastwick (1864) bought a specimen 4.5feet long (1.37m) in the Safid River which had a 7lb (3.2kg) fish in its stomach. De Mecquenem (1908) reported that they reached 2m in the Lake Orumiyeh basin and Anonymous (1977) reports fish from there at 400lbs (= ca. 182kg). Asghar Abdoli kindly sent me a photograph of a specimen from the Aras Dam caught 5 October 1994 which was 2.25m long and weighed about 90kg.

Distribution: This species is found in Europe, Central Asia and Southwest Asia. In Iran, it is found from the Aras River and Dam, along the whole Caspian coast from the Astara to the Atrak rivers including the Anzali Talab (= Mordab, Lagoon or Wetland) and its Siah Keshim Protected Region and the Siahdarvishan River, the Safid River, the Manjil Dam on the Safid River, the Shahrud, the Amirkelayeh Lagoon near Lahijan, the Rasteh, Sheikan, Chamkhaleh and Haraz rivers, the Karfestan Ab-bandan ay Roudsar, Gorgan River and Bay, and from the southwest Caspian Sea and south-central Caspian Sea; and in the Lake Orumiyeh basin including the Nowruzlu Dam, Shapur-e Avval Reservoir, Zarrineh and Simineh rivers, Mahabad Chay, Mahabad Reservoir, Gader Chai at Ocksa (Günther 1899; Nedoshivin & Iljin 1929; Berg 1936; Nümann 1966; Holčík & Oláh 1992; Nejatsanatee 1994; Riazi 1996; Abbasi et al. 1999; Kiabi et al. 1999; Jolodar & Abdoli 2004; Alipour et al. 2007; Abdoli & Naderi 2009; Ashoori 2010; Yakhchali et al. 2012; Pouyafar et al. 2013; Coad 2014). Also reported from the Karakum Canal and Kopetdag Reservoir in Turkmenistan (Aliev et al. 1988; Shakirova & Sukhanova 1994; Sal'nikov 1995), introduced to the Tedzhen and Morghab rivers of Turkmenistan (Sal'nikov 1998), and may enter Iranian waters of the Tedzhen (= Hari) River basin.

Abdoli (2000) maps this species from lower Gorgan, Neka, Babol, Heraz, Chalus, Tonekabon, and Safid rivers, the Anzali Talab, along the Caspian coast, and in the middle Aras River, and in the lower Talkheh and Zarrineh rivers of the Lake Orumiyeh basin.

Also said to occur in the Tigris-Euphrates basin in Iraq but this needs specimens for confirmation. Ciepielewski et al. (2001) considered that there were two species in the Dukan and Derbendikhan dams of northern Iraq and rare specimens from southern Iraq appear different from *S. triostegus* (N. A. Hussain, pers. comm. 2005).

Zoogeography: Triantafyllidis et al. (2002) found no consistent pattern of geographical structuring for *S. glanis* using 10 microsatellite loci in contrast to other European freshwater fish species. They suggest recent dispersal from only one glacial refugium in the Ponto-Caspian region (see Esmaeili et al. 2014).

Habitat: This large species is found in the larger water bodies such as rivers, lakes and marshes over soft bottoms and can tolerate brackish water (even for spawning) and moderately low oxygen levels. Warm, deep waters with slow current are preferred. It is active at night. Adults are solitary and found under overhanging banks or submerged trees. This catfish overwinters in aggregations on river beds. Resumed activity in spring depends on the local water temperature regime, probably as early as March in Iran. Riazi (1996) reports that this species is native (resident) to the Siah-Keshim Protected Region of the Anzali Talab (Fig. 12). Knipovich (1921) reports this species from depths of 23.8-25.6m in the Iranian Caspian Sea. Khodabandeh and Shahriari Moghadam (2006, 2007) examined the immunolocalisation and ultrastructure of ionocyte cells which play an active role in osmotic regulation in this fish.

Movements, such as hunting for food, are stimulated by such environmental factors as temperature, solar radiation, air pressure and turbidity after rain. It is sensitive to extra-aquatic sounds. The head canal system is very sensitive and can track prey over distances up to 55 times the length of the prey and follow signals up to 10 seconds old (Kottelat & Freyhof 2007).

Age and growth: Life span is 22 years for males and 16 years for females in the Volga Delta. Growth is

Fig.12. Anzali Lagoon, 23 August 1974, habitat of *Silurus glanis*, courtesy of N.B. Armantrout estate.

most intensive in the first years of life. After maturity the annual increase in length is 5-7cm. Relative weight increase is very high (30%) while length increase is 6-10%. June-July is the period of greatest length increase while weight increase takes place mainly in autumn. Maturity begins at 3-4 years, 57-66cm and 1.3-2.3kg but may be as early as 2 years, 51-52cm and 1.2-2.2kg or as late as the sixth year (Orlova 1988). Maximum life span is 80 years (IUCN 2013; accessed 26 November 2014).

Abbasi & Valipour (2005) found 9 age groups in the Anzali Lagoon with females making up 68.5% of fish caught. Total length of 95 fish was 19.8-186.5cm and weight was 47.7-30,000g. Nezami Balouchi et al. (2007) found age groups 1^+ to 7^+ in the Amirkelayeh Wetland with an average total length of 50.6cm (range 32.5-73.0cm) and an average weight of 944.2g (range 200-3000g). Alipour et al. (2007) recorded a maximum age of 7^+ years in the Chamkhaleh River with fish at ages 3-4 years being the most common. The average weight of 127 specimens was 906.6gm and the average total length was 48.55cm.

Food: Food in the Volga Delta includes such fishes as *Cyprinus carpio*, *Abramis brama*, *Scardinius erythrophthalmus* and, prior to the regulation of the Volga, *Rutilus rutilus* (and/or *R. caspicus*) and herrings (Clupeidae). Crustaceans now form part of the diet there (Orlova and Popova 1976, Orlova 1988). At one time this catfish in the Volga delta ate 62-68% of its annual food in one month in spring

when the Caspian roach (*Rutilus rutilus* - this may be *R. caspicus*) arrived on its spawning run. In the Kura region, commercial fishes such as *Cyprinus carpio*, *Abramis brama*, *Rutilus rutilus* (and/or *R. caspicus*), *Aspius* (= *Leuciscus*) *aspius*, *Sander lucioperca*, *Chalcalburnus* (= *Alburnus*) *chalcoides*, *Barbus* (= *Luciobarbus*) *brachycephalus* or *Barbus* (= *Luciobarbus*) *capito*, and *Silurus glanis* make up 30.27% by frequency and 20.18% by weight, non-commercial species such as *Scardinius erythrophthalmus*, *Tinca tinca*, *Cobitis* spp., *Rhodeus amarus*, *Pungitius platygaster*, *Atherina boyeri* (= *caspia*) *Alburnus alburnus* (= *hohenackeri*), *Blicca bjoerkna*, and *Caspiomyzon wagneri* make up 50.68% and 33.79% respectively, marine fishes such as Clupeidae, Mugilidae, and Gobiidae make up 12.90% and 8.60%, respectively, and crustaceans 25.64% and 17.09%, respectively (Mamedov and Abbasov 1990). In Azerbaijan, Abdurakhmanov (1962) reports *Gobio gobio* to comprise 22.4% of the diet, *Caspiomyzon wagneri* 15.7% and eggs 2.2%, *Chalcalburnus* (= *Alburnus*) *chalcoides* 10.2%, *Alburnus alburnus* (= *hohenackeri*) 10.2%, *Cobitis taenia* (cf. *keyvani*) 9%, *Barbus lacerta* 7.8%, *Barbus* (= *Luciobarbus*) *capito* 6.7%, *Chondrostoma oxyrhynchum* 5.6%, *Capoeta capoeta* 3.4%, *Blicca bjoerkna* 2.2%, and loaches 4.5%.

Alosa caspia, a clupeid, forms a substantial part of the diet of *Silurus glanis* in the Anzali Lagoon (Holčík & Oláh 1992). The lamprey, *Caspiomyzon wagneri*, and young sturgeons are also eaten by this catfish. Also in the Lagoon, according to Abbasi & Valipour (2005), this catfish ate 78.6% bony fishes, 15.8% crustaceans, 4.13% insects, 0.9% amphibians and 0.5% bivalves. *Carassius auratus* dominated at 33.9%, followed by the crustacean *Macrobrachium* spp., at 14.22%, *Neogobius kessleri* (= *Ponticola gorlap*) at 4.59% and *Proterorhinus marmoratus* (= *nasalis*) at 2.75%. *C. auratus* dominated in spring and autumn, *Macrobrachium* spp. in summer and *N. kessleri* in winter. Consumption of fish increased with size, being 44.2% at 20-55cm and 94.5% at 91-125cm. Cannibalism was not observed and

commercial fish stocks were not consumed. The alien freshwater prawn, *Macrobrachium nipponense*, was fed on by catfish 22-147cm and 1-8 years old in the Anzali Lagoon, comprising 30% of gut contents (Ghane 2013). Catfish in the Amirkelayeh Wetland fed principally on *Tinca tinca* and amphipods each at a frequency of 36.3%, along with minor amounts of *Blicca bjoerkna*, *Pungitius platygaster*, *Perca fluviatilis*, *Proterorhinus marmoratus* (= nasalis), *Carassius auratus*, *Cobitis keyvani* (identified as *C. taenia*), frogs, rats, birds, water bugs and beetles, plecopterans and odonatans (Nezami Balouchi et al. 2007). They were also cannibals. Alipour et al. (2007) recorded the most frequent food (56.66%) in catfish from the Chamkhaleh River as other fishes, but stomach contents also included frogs, crustaceans, insects, water plants, mice and aquatic birds. *Ballerus sapa*, a very rare species in the Iranian Caspian Sea basin has been recorded as being eaten by this catfish (Derzhavin 1934).

Generally a wide variety of fishes is taken along with crayfish, frogs and even birds and small aquatic mammals. It is a voracious predator but stories of attacks on dogs and small children are more legendary than factual although human remains may be scavenged (Gudger 1945). Active feeding occurs at water temperatures above 8°C so winter feeding is minimal or absent. While feeding often occurs at night, catfish can be heard feeding in the evenings by the snapping of the mouth and tail strikes on the water. In cloudy water conditions they come into shallow water to take earthworms, grasshoppers and frogs washed in from nearby fields (Mihálik 1982).

Young catfish feed on plankton, particularly Cladocera such as *Daphnia*, *Chydorus*, *Alona* and *Bosmina* among others. Later the diet involves mosquito larvae, larger crustaceans, organisms associated with the river bank, worms, snails and young fishes. Cannibalism occurs if food is short (Mihálik 1982).

Reproduction: Behmanesh et al. (2009) found the maximum mean gonadosomatic index for Anzali Lagoon fish was in May and June, decreasing to September. Maximum values for gonad maturity were in April-May at water temperatures of 19.3-22.7°C. Spawning was from April to mid-June.

Non-intermittent spawning in Dagestan takes place in late May and continues to the middle of July when the eggs of females mature at a water temperature of 20-22°C. Spawning rarely occurs below 20°C. Males may actually have running milt 30-40 days earlier than this and also later, a longer potential spawning season. Adhesive yellow eggs are laid in depressions in weed beds, formed by the male pressing on the plants. Fecundity is up to 285,000 eggs with diameters around 2-3mm (to 467,000 elsewhere). Elsewhere spawning may be intermittent (Shikhshabekov 1978).

The male guards the incubating eggs, even during the day, moving his tail fin every 3-5 minutes to ensure adequate oxygen supplies. Nests in Europe may be on the fine roots of plants which hang freely in the water. The nest is in shallow, 40-60cm, water. Males pursue females just under the water surface, an indication spawning will occur the same evening or the next day. Spawning usually occurs in the evening, often before a thunderstorm on warm and stifling days. The male nudges the female in the anal region, swims under her and may lift her so that her back is above water, the male wraps himself around the female for 10-12 seconds, the male and female separate and the female sinks slowly to the bottom and discharges eggs, the male following to release milt. This process can be repeated several times over 1.5-2.0 hours and the water around the nest is milky from sexual products. Eggs hatch after 2.5-3.0 days at 23-25°C. Larvae are light sensitive and die in direct sunlight and also if water temperature falls below 13-14°C (Mihálik 1982).

Parasites and predators: Mokhayer (1976) cites Iranian records for the digenetic trematodes *Aphanurus stossichi* and *Bunocotyle cingulata*, the nematode larvae *Anisakis* sp. and the nematode adults *Cucullanus sphaerocephala*, and the acanthocephalan *Corynosoma caspicum*. Ataee and Eslami (1999, www.mondialvet99.com, accessed 31

May 2000) report the helminth *Mazocea alaosa* from the gastro-intestinal tract of fish from the Anzali Wetland. Masoumian et al. (2005) recorded the protozoan parasite *Trichodina perforata* from this species in the Aras Dam in West Azarbayjan. Khara et al. (2006) record the eye fluke *Diplostomum spathaceum* for this fish in the Amirkelayeh Wetland in Gilan. Sattari et al. (2005) surveyed this species in the Anzali and Amirkelayeh wetlands, recording *Raphidascaris acus*, *Raphidascaroides* sp. and *Eustrongyloides excisus*. Khara et al. (2007) found fish from the Amirkelayeh Wetland to have *Diplostomum spathaceum*, *Gyrodactylus* sp., *Lernaea cyprinacea*, *Dactylogyrus* sp., *Raphidascaroides* sp., *Aphanurus stossichi* and *Triaenophorus crassus*. Barzegar et al. (2008) record the digenean eye parasite *Diplostomum spathaceum* from this fish in Iran. Amini et al. (2009) found lesions in the intestine of fish from the Zarrineh River caused by such parasites as the trematode *Plagioporus skrjabini* and the acanthocephalan *Corynosoma strumosum*. Barzegar and Jalali (2009) reviewed crustacean parasites in Iran and found *Cyprinacea* sp. and *Ergasilus* sp. on this species. Pazooki & Masoumian (2012) record the nematodes Anisakis schupakovi and *Rhabdochona fortunatowi* from Iranian fish (the latter species listed as *S. triostegus* but the localities include West Azerbaijan and Mazandaran). Yakhchali et al. (2012) found the helminths *Orientocreadium siluri*, *Crowcrocoecum skrjabini* and *Bothriocephalus gowkongensis* in catfish from the Zarrineh River in the Lake Orumiyeh basin.

Khara & Sattari (2014) found 7 parasite species in their most recent survey of fish from the Amirkelayeh Wetland, namely *Raphidascaroides* sp. (nematode), *Triaenophorus crassus* (cestode), *Aphanurus stossichi* and *Diplostomum spathaceum* (digenean trematodes), *Silurodiscoides vistulensis* and *Silurodiscoides siluri* (monogenean trematodes), and the copepodid stage of *Lernaea cyprinacea* (crustacean). *L. cyprinacea*, *Raphidascaroides* sp. and *T. crassus* are reported for the first time from

S. glanis in Iran.

Daghigh Roohi et al. (2014) examined 86 fish from the Anzali Wetland and reviewed earlier works on parasites of this catfish there not cited above. Species recorded from these reports were the protozoans *Ichthyophthrius multifilis* and *Trichodina* sp., the nematodes *Aniskais* sp. larvae, *Cucullanus sphaerocephalus*, *Raphidascaris acus*, *Raphidascoroides* sp. and *Eustrongylides excisus* larvae, the acanthocephalans *Acanthocephalus lucii*, *Corynososma strumosus* and *Pomphorhynchus perforator*, the cestodes *Bothriocephalus* sp., *Proteocephalus osculatus*, *Silurotaenia siluri*, *Triaenophorus crassus*, the digenean trematodes *Aphanurus stossichi*, *Bunocotyle cingulata*, *Diplostomum spathaceum* and *Orientocreadium siluri*, the monogenean trematodes *Silurodiscoides siluri* and *S. vistulensis*, and the crustaceans *Argulus foliaceus* and the copepodid stage of *Lernaea cyprinacea*.

Lactobacillus bacteria have been found in 30% of the intestines of fish from the Siahdarvishan River by Pouyafar et al. (2013). Listeria contaminates fish from Urmia markets (Modaresi et al. 2011) and this bacterium can cause serious disease in humans with a mortality rate at about 20%.

Little egret chicks, *Egretta garzetta*, are fed this catfish in the Karfestan Ab-bandan, Roudsar (Ashoori 2010). The Caspian seal, *Pusa caspica*, is a predator on this species (Krylov 1984).

Economic importance: There is some opportunity for sport fishing for this species in the Anzali Talab and Lake Orumiyeh (Urmia) basin where it will take spinners and spoons as well as frog live bait. It reputedly puts up a tremendous fight (Anonymous 1977).

Nevraev (1929) reports on catches in various regions of Iran in the early years of the twentieth century. There were no evident trends of increase or decrease. In the Astara region from 1901-1902 to 1913-1914 the catch varied irregularly from 699 to 4031 fish, in the Anzali region from 1901-1902 to 1918-1919 the catch varied from 18,177 to 206,485

species is of great commercial importance in Dagestan (Shikhshabekov 1978). The roe has been used as a form of caviar and glue has been made from the gas bladder and bones. In the Lake Orumiyeh basin this fish was used as fertilizer since, being scaleless, it could not be eaten for religious reasons (De Mecquenem 1908) although it appears on modern fish markets in Urmia (Modaresi et al. 2011). Its export value is recognised and studies have been carried out on this species such as the effect of ascorbic acid and citric acid on the lipid stability and rancidity inhibition of fillets in frozen storage (Pourashouri et al. 2008a, 2008b; Pourashouri et al. 2009).

As a predator, this catfish may cause stock depletion in fry stocking areas of the Caspian Sea for such species as *Abramis brama* (Saiad Borani 2001). Robins et al. (1991) list this species as important to North Americans. Importance is based on its use as food, for industrial processes (such as fertilizers, fish meal, pet food, novelty products although not specified for this species), in sport, and in textbooks. The gas bladders were used for isinglass in the Caspian Sea basin (Lönnberg 1900). Zonn et al. (2009) considered it to be a biomeliorant in the Aral Sea basin as it ate trash fish.

This species has been implicated in ichthyootoxism. The presence of venom associated with the pectoral fins (Coad 1979) needs definitive examination.

Conservation: Lelek (1987) classifies this species as rare to vulnerable in Europe because of habitat changes and angling pressure. Kiabi et al. (1999) consider this species to be of least concern in the south Caspian Sea basin according to IUCN criteria. Criteria include commercial fishing, sport fishing, medium numbers, habitat destruction, widespread range (75% of water bodies), present in other water bodies in Iran, and present outside the Caspian Sea basin. Vulnerable in Turkey (Fricke et al. 2007) and listed as Least Concern by the IUCN (2013) (accessed 26 November 2014).

Population numbers need to be monitored

Fig.13. Dipnet, Gholab Ghir River, Gilan, used to catch *Silurus glanis*, 5 June 1978, B.W. Coad.

fish, in the Safid River region from 1899-1900 to 1917-1918 the catch varied from 3290 to 43,835 fish, in the Mazandaran region from 1906-1907 to 1913-1914 the catch varied from 5282 to 11,283 fish, and in the Astrabad region from 1902-1903 to 1912-1913 the catch varied from 3500 to 26,200 fish. The commercial catch in Iran from 1956/1957 to 1961/1962 varied between 4,913kg and 37,630kg (Vladykov 1964) and from 1965/66 to 1968/69 varied from 11 to 31 tonnes (Andersskog 1970) but in the 6 years from 1980 to 1985 catches were recorded by the Food and Agriculture Organization, Rome as respectively 2, 2, 0, 2, 3, and 0 tonnes. The catch has been as high as 107,593kg for the Anzali region alone in 1934/1935 (Vladykov 1964). Holčík & Oláh (1992) report a catch of 2663kg in the Anzali Talab in 1990, at 3.6% of the catch the sixth most important fish there, and from 1932-1964 reported catches varied from none to 12.6 tonnes annually. Dipnet, is usually used to catch *S. glanis* in some rivers of Gilan (Fig. 13). The Iranian fishery peaks in October and in April (Farid-Pak no date). This

carefully as it is fished for although it lacks scales. Populations in isolated basins have not been examined in detail for their relationships to see if they are distinct.

Sources: Kobayakawa (1989) revised the genus *Silurus* and his data are incorporated here. Mihálik (1982) reviewed the biology of this catfish. Further details on collections examined can be found in the museum catalogues.

Iranian material: CMNFI 1970-0509, 1, 131.2mm standard length, Gilan, Safid River at Hasan Kiadeh (37º24'N, 49º58'E); CMNFI 1979-0685, 2, 63.9-107.7mm standard length, Gilan, Safid River below Dehcha (ca. 37º22'N, ca. 50º06'E); CMNFI 1979-0788, 2, 293.5-335.6mm standard length, Mazandaran, Gorgan River at Khvajeh Nafas (37º00'N, 54º07'E); CMNFI 1979-1236, 1, 269.0mm standard length, Mazandaran, Gorgan River at Khvajeh Nafas (37º00'N, 54º07'E); CMNFI 1980-0123, 1, 225.3mm standard length, Gilan, Safid River around Dehcha (37º22'N, 50º06'E); CMNFI 1980-0905, 1, 208.0mm standard length, Mazandaran, Gorgan River at Khvajeh Nafas (37º00'N, 54º07'E); OSU 4278, 2, 227.2-280.2mm standard length, Azarbayjan-e Bakhtari, Zarrineh River (no other locality data).

Silurus triostegus Heckel, 1843
(Figs. 14-16)
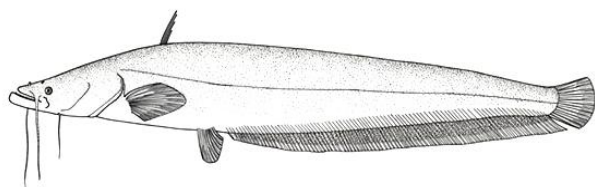
Fig.14. Line drawing of *Silurus triostegus* by S. Laurie-Bourque.

Common names: Esbele, and jirri, yeri, yery, yari or iry (= eel), esbele-ye beinolnahrein (= Mesopotamian catfish); sag mahi (= dog fish) in Khuzestan; gorbeh mahi (= catfish). [djirri, jirri, girri or yerri (= eel) in Arabic; Mesopotamian catfish, Tigris catfish, Asian djirri].

Fig.15. NMW 92345, syntype of *Silurus triostegus*, Tigris River near Mosul, ca. 582mm standard length, photograph courtesy of B. Herzig, Naturhistorisches Museum Wien.

Fig.16. Head of *Silurus triostegus*, CMNFI 2008-0132, 319.9mm standard length, Khuzestan, B.W. Coad.

Systematics: *Silurus chantrei* Sauvage, 1882, a species with 4 barbels, was described from the "Fleuve Koura à Tiflis (= Kura River at Tbilisi, Georgia) but was possibly based on material from the Tigris-Euphrates basin (Berg 1948-49; Haig 1952) and may well be a synonym of this species. Two syntypes of *Silurus chantrei*, 160-170mm total length, are in the Muséum national d'Histoire naturelle, Paris under MNHN A.3932 (Eschmeyer et al. 1996). Günther (1899), Banister (1980) and Hora & Misra (1943) considered that *S. triostegus* may not be distinct from *S. glanis* but Coad & Holčík (2000) detail differences and Krieg et al. (2000) support this

latter analysis on the basis of mitochondrial DNA.

The type locality of *Silurus triostegus* is the "Tigris bei Mossul" according to Heckel (1843) and the description was based on 4 specimens although the catalogue in Vienna lists 1 specimen in spirits and 2 stuffed specimens. The card index in Vienna in 1997 lists only NMW 92345 as a dried syntype. Coad & Holčík (2000) found only a single stuffed type, ca. 582mm standard length. Eschmeyer et al. (1996) list 1 dried syntype of *triostegus* in the Senckenberg Museum Frankfurt (SMF 2623, formerly NMW) and this has a standard length of ca. 710mm. An image of *S. triostegus* (SMF 2623) is available at:http://acsi.acnatsci.org/base/image_show_wrapper.html?target=221708.

Key characters: This species differs from *S. glanis* by having robust and longer teeth (snaggly, catching on flesh and, in preserved fish at least, lower jaw teeth are exposed when the mouth is closed), the upper and lower jaws meet at a dorsal and superior position (antero-dorsal in *S. glanis*), a distinctly and coarsely serrate pectoral fin spine posteriorly, and a lighter colour. Maxillary barbel length is about equal to head length while in *S. glanis* it is much longer on average, although there is some overlap. Anterior mandibular barbels (when present) are always shorter than posterior mandibular barbels while in *S. glanis*, the anterior mandibular barbels are always longer (Ünlü and Bozkurt 1996).

Morphology: Bears 4 barbels in some specimens as opposed to the usual 6 in *S. glanis* but there is evidence that the four-barbelled *Silurus* (sometimes placed in a distinct genus *Parasilurus* Bleeker, 1862, e.g., in Berg (1949), now synonymised with *Silurus* - see Eschmeyer (1990) and Ráb et al. (1994)) have 6 barbels when young and one pair of mandibular barbels is reabsorbed (see Haig (1952) and Al-Daham & Al-Seyab (2001)). Specimens with one pair and with two pairs of mandibular barbels have been reported (Kobayakawa 1989). Ünlü & Bozkurt (1996) and Ünlü et al. (2012) record 4 mandibular barbels (2 pairs) in 3 specimens, 3 barbels in 1 specimen and 1 pair in another specimen for Turkish

Euphrates fish. In *S. triostegus*, the adults apparently lose one pair of barbels (Krupp, *in litt.* 1992). Coad & Holčík (2000) found all *S. glanis* in their study had 4 mandibular barbels (2 pairs) while in *S. triostegus* 11 fish had 4 mandibular barbels and 12 fish lacked the posterior mandibular pair. There was no apparent trend in barbel loss associated with increase in body size.

The pectoral fin spine is strongly to moderately serrated on its inner surface and smooth on its outer surface. Vomerine teeth are in two patches, not one as in *S. glanis* (Kobayakawa 1989), although Ünlü & Bozkurt (1996) record some specimens of *S. triostegus* with only one patch. The maxillary barbel reaches only to the end of the head, not much longer as in *S. glanis*. However, Ünlü & Bozkurt (1996) and Ünlü et al. (2012) report that maxillary barbels are longer than the head and later that they reach the end of the head; it is suggested here that barbel length varies individually. The lower jaw is longer than the upper jaw. Teeth in both jaws are recurved, the band of teeth is wider than in *S. glanis*, and the teeth are stronger and longer. The eye is larger than in *S. glanis*.

Dorsal fin branched rays 3-4 (counts of 3 rays are more common than in *S. glanis*; 3 in ten fish and 4 in thirteen fish examined by Coad & Holčík (2000)), pectoral fin branched rays 11-14 with 1 spine, pelvic fin branched rays 8-13 after 1 unbranched ray, anal fin rays 77-94, vertebrae 16-17+52-53=69-70, and total gill rakers 12-17, reaching the one below when appressed (Coad &Holčík 2000). The stomach is large, and apparently more elongate than in *S. glanis* although this may be distortion due to food content. The intestine has about 3 loops.

Sexual dimorphism: Unknown.

Colour: The upper body is mottled pale yellow-brown and black. Overall colour may appear dark or light and yellowish. Generally much lighter than *S. glanis*. The belly and lower head are white with the belly having black spots. Maxillary barbels and margin of the lower jaw are very dark brown.

Size: Reaches 1.5m in the Syrian Euphrates (Gruvel

1931), and to more than 2.0m (Krupp 1992) and more than 50.0kg accoring to Machacek (1983-2012, accessed 27 July 2012).

Distribution: This species is found in the Tigris-Euphrates basin including its Iranian portion in Khuzestan and such rivers as the Arvand, Bahmanshir, Karun, Karkheh, Dez and Jarrahi (Najafpour 1997; Eskandary et al. 1999; Abdoli 2000; Esmaeili et al. 2010).

Zoogeography: This species is presumably a relative of *S. glanis* but its closest affinities may lie with species to the east. Differentiation of the two species may have occurred around the Middle to late Miocene but this requires further study (Coad & Holčík 2000).

Habitat: van den Eelaart (1954) reports this species from open and vegetated lakes and marshes and rivers in Iraq. The larger fish are mostly confined to rivers, entering marshes and lakes only on floods. The young have a greater tolerance of high temperatures and low oxygen. It was one of the most abundant species in the southern Iraqi marshes in the 1980s (Hussain & Ali 2006). The artificial changes imposed on the marshes of southern Iraq resulted in this predatory fish increasing in numbers; the food pyramid was reversed with the smaller carp species low in numbers (http://news.bbc.co.uk, accessed 26 August 2005). Hussain et al. (2008) attribute the increase in this species to a loss in predators such as otters and aquatic birds and the abundance of smaller fishes as food. In the Shadegan Marsh, *S. triostegus* increased while *Aspius* (= *Leuciscus*) *vorax*, *Luciobarbus pectoralis* and *Cyprinus carpio* decreased with changes in environmental conditions. Variations in fish biomass were attributed to loss of floodplain areas, dam construction altering the hydrological regime, increased salinity from irrigation, and pollution (Hashemi et al. 2012).

Asadi et al. (2011), using gill nets at three stations in the Hoveyzeh Marsh, found 19 fish species with *S. triostegus* at 6.4%. The average water temperature of the marsh was 21.1°C, salinity was 1.79‰ and pH was 7.5.

Age and growth: Length-weight relationships for fish from the Shadegan Wetland, Khuzestan were $W=0.06xL^{2.62}$ for males and $W=0.02xL^{2.79}$ for females. The *b* value did not differ significantly between sexes. Fish were 11.9-65.0cm long and weighed 75 to 2000g (Hashemi et al. 2012). Hashemi and Ansary (2012) found production in the Shadegan Wetland was 33.38kg/ha/yr, second only to the cyprinid *Carasobarbus luteus* at 40.1kg/ha/yr. While 518 of this catfish were caught, only 3 *H. fossilis* were captured in 2010-2011. Biomass of *S. triostegus* increased over the period 1997-2009.

Al-Abood (1989) found age groups 2 to 7 years for fish from a marsh area north of Basrah, Iraq in 6 weight groups from 300 to 3900g. Al-Hassan & Al-Sayab (1994) examined 600 specimens from the Hawr al Hammar north of Basrah for age using vertebrae and eye lens diameter and found 6 age groups. Oymak et al. (2001) describe 11 age groups in Atatürk Dam Lake, Turkey with females having higher L_∞ (202.85cm versus 113.98) and lower K (0.046871 versus 0.101972) values than males. The length-weight relationship for females was log W=-4.9431+2.9589 log L (r=0.9801) and for males log W=-4.7550+2.8824 log L (r=0.9678) and the von Bertalanffy equations were $W_t=59953.87$ $[1-e^{-0.046871(t+2.0515)}]^{2.8824}$ for females and $W_t=12624.72$ $[1-e^{-0.101972(t+1.6876)}]^{2.9589}$ for males. Mean condition factors for females and males were 0.99055 and 0.95625 with highest factors in April and the lowest in December. Males matured at age 3, a mean standard length of 326mm and a mean weight of 760.4g and females at age 4, 332.8mm and 420.4g.

Food: Fish are an important food including *Liza abu* (=*Chelon abu*) and *Acanthobrama marmid* in the Iraqi marshes and presumably those across the border in Iran (Al-Shamma'a & Jasim 1993; Ünlü & Bozkurt 1996; Dawood 1997; personal observations). Aquatic insects are also taken but fish predominate. The food in Hawr al Hammar, Iraq was predominately fish (*Liza abu*, *Aphanius* spp., *Aspius* (= *Leuciscus*) *vorax*, *Thryssa* spp., *Acanthobrama marmid*, *Silurus triostegus* (young less than 16cm were eaten by

adults longer than 35cm), *Barbus* (= *Mesopotamichthys*) *sharpeyi*, *H. fossilis* and *C. carpio*) followed by shrimps (mainly *Metapenaeus affinis*), frogs (*Rana esculenta*) and crabs (mainly *Sesarma boulengeri*) with relative importance indices of 70.8, 16.3, 6.4 and 4.9, respectively (Al-Daham and Al-Seyab 2000). *Liza abu* was the most important fish through most of the year (except July and August when absent) (relative importance index 42.0, followed by *C. carpio* at 11.5), in numerical abundance and total weight. During July the prey was *B. sharpeyi and C. carpio* and in August prey was restricted to *C. carpio*, presumably opportunistic feeding. Other fish species were mostly young of the year and of minor importance. The diet at Al-Fuhoud in the Hawr al Hammar was 70.7% fish by volume (Al-Shamma'a 2005). Aquatic insects are also taken but fish predominated. Dawood (1997) also studied diet in the southern Hammar Marsh and found fish to be the most important prey year round while shrimps (*Metapenaeus affinis*) and molluscs were important in certain months (mostly absent April-August). The disappearance of shrimps probably relates to their migratory pattern. Aquatic insects were found mostly in the spring. There is a reverse relationship between the presence of fish and shrimps. Fish and shrimps increased in the diet with increase in size while aquatic insects, molluscs and small crustaceans decreased with size. Fish species eaten were Liza abu, *Barbus* (= *Carasobarbus*) *luteus*, *Alburnus* sp., *C. carpio*, *T. hamiltoni*, *H. fossilis*, *Aphanius* sp., *G. holbrooki* and *S. triostegus*. Frogs, detritus and aquatic plants were also found in the gut contents. Feeding occurred more at night and with another peak in late afternoon. The index of fullness values increased in April-September when water temperatures and metabolic rate rose. Spawning females do not feed (Al-Daham & Al-Seyab 2000).

This species is an important predator in the Iraqi marshes where their biomass is high although they are relatively few in numbers (N. A. Hussein, pers. comm. 2005). Hussain & Ali (2006) examined feeding relationships among fishes in the Hawr al

Hammar and found this species to be a carnivore, 73.7% of the diet being fish and 20.2% crustaceans. In another study of the recovering Hawr al Hammar, diet was 60.6% fish and 35.2% shrimps, in the Hawr al Hawizah Marsh 79.2% fish and 20.8% shrimps, and in the Al Kaba'ish (= Chabaish) Marsh 80.6% fish and 15.0% shrimps with plants, insects and snails at less than 10% each (Hussain et al. 2006). The rare cyprinid species *Hemigrammocapoeta elegans* was found in the gut of a *S. triostegus* taken at Harmaleh on the Dez River (Fig. 17).

Fig.17. Dez River at Harmaleh, 27 November 2000, habitat of *Silurus triostegus*, Brian W. Coad.

Reproduction: Spawning takes place in March-May in Iraq (van den Eelaart 1954; Al-Hassan et al. 1990; Al-Daham & Al-Seyab 2000) to May and June in Turkey (Oymak et al. 2001). Al-Rudainy (2008) gives sexual maturity in Iraq at 3 years, 50cm total length and 1kg weight, spawning in May and continuing for a few months, eggs being deposited on vegetation and egg diameters up to 4.2mm.

Fecundity in the Hawr al Hammar ranged from 5327 to 333,390 eggs for fish 32.5-92.0cm total length, 395-5595g weight and 1-7 years of age (Al-Daham & Al-Seyab 2001). This study showed that fish migrated to shallowly inundated areas for spawning among aquatic plants, namely the coast clubrush with sparse bulrush and common reed. Water depth was 0.25-0.75m, the substrate was clay or sandy clay, the water was not flowing, temperatures were 17-21ºC, dissolved oxygen 6-11p.p.m., alkalinity 170-203 (as calcium carbonate

p.p.m.), pH 8.4-9.0 and salinity 5.0-5.3‰. The fish migrated in small schools, sometimes in association with *Barbus* (= *Mesooptamichthys*) *sharpeyi*, and arrived on the spawning grounds in the first week of March. Spawning took place at dawn and during the last light after sunset. The male, sometimes two males, rushed towards the female, chasing her and the rotating around her such that their bodies came into contact and a strong jerk was elicited from the female. Eggs were scattered on the bottom and not guarded. Males and females separate and retreat to deeper water. The eggs are adhesive, transparent and range in size from 3.0-3.2mm. Peak spawning is in March with minor spawning in April and May. Larvae were first seen on 2 March, eggs hatching in 48-60 hours at 18-22ºC.

The highest condition factors were found in April in Atatürk Dam Lake, Turkey, the mean egg diameter was greatest in May at 1.937mm and fecundity attained 120,300 eggs (Oymak et al. 2001).

Parasites and predators: Mortezaei et al. (2000) report an infection rate of 33.3% (2 of 6 fish) with the parasitic worms *Proteocephalus* sp. in this species from Khuzestan marshes. Pazooki and Masoumian (2012) record the nematodes *Rhabdochona denudata* and *R. fortunatowi* from Khuzestan fish.

Economic importance: This species forms 8.5% of the total catch in Iraq (Das et al. 1978), the total catch in 1976 being 691t (Petr 1987), but it is not a popular food. As a scaleless fish it is not eaten by Shi'a Muslims. Andersskog (1966) gives a catch of 40-50t exported to Lebanon from Iraq annually. It was found to have potential for use as a protein concentrate and food as it has a high protein content (Jasim et al. 1988, 2006; Al-Badri et al. 1993; Al-Habbib et al. 1993; Mahdi et al. 2005). Cengiz et al. (2012) found that Tigris River, Turkey fish were a desirable human food item being nutritious based on fatty composition. Fish from Atatürk Dam Lake, Turkey also had a rich lipid content but lower mineral and protein content than other economically important freshwater fishes in Turkey.

van den Eelaart (1954) gave the fishing season in Iraq for this species as January-April (peaking in March) and September-November (peaking in October) in rivers, and July-November (peaking August-September) for lakes and marshes.

It was caught on rod and line by foreign soldiers fishing for sport in Iraq at Camp Liberty, Baghdad (www.carpecapio.com, accessed 26 August 2005). Some used plastic worms as bait.

Conservation: This species is not commonly collected in Iran but this may be a consequence of habitats sampled and gear used. It may be under some threat as it is fished for, at least in neighbouring Iraqi waters. Population numbers have not been examined for fish in Iran nor are its biology or relationships well known. Listed as Least Concern by the IUCN (2013) (downloaded 26 November 2014).

Sources: Kobayakawa (1989) revised the genus *Silurus* and his data are incorporated here as is the data of Ünlü and Bozkurt (1996) for Turkish Euphrates specimens. Further details on collections examined can be found in the museum catalogues.

Type material: See above. Iranian material: CMNFI 1993-0133, 1, 192.9mm standard length, Khuzestan, probably Karun River at Ahvaz (31º19'N, 48º42'E); CMNFI 2008-0132, 1, 319.9mm standard length, Khuzestan (no other locality data); SNM-YR 6421, 1, 325.6mm standard length, Khuzestan, Karun River at Ahvaz (31º19'N, 48º42'E); ZSM 21832, 1, 406.0mm standard length, Khuzestan, Dez River at Harmaleh (31º57'N, 48º34'E); ZSM 21833, 1, 425.4mm standard length, Khuzestan, Dez River at Harmaleh (31º57'N, 48º34'E); uncatalogued, 1, 317.7mm standard length, Khuzestan, probably Karun River at Ahvaz (31º19'N, 48º42'E).

Comparative material: BM(NH) 1874.4.28:3-5 and 1875.1.14:8 (same jar), 4, 236.7-511.5mm standard length, Iraq, Tigris River near Baghdad (ca. 33º21'N, ca. 44º25'E); BM(NH) 1888.5.17:1, 1, 336.2mm standard length, Iraq, Fao, presumably a fish market (no other locality data); BM(NH) 1893.6.23:26-28, 3, 254.3-425.7mm standard length, Iraq, Fao (no other locality data); BM(NH) 1892.9.1:26, 1, 270.8mm standard length, Iraq, Fao (no other locality data);

BM(NH) 1920.3.3:167-176, 13, 123.1-490.9mm standard length, Iraq, Basrah (30°30'N, 47°47'E).

Family Sisoridae

The sisorid or sucker catfishes are found in Asia from Turkey as far east as Borneo. There are about 18 genera with about 196 species (Nelson 2006; Eschmeyer & Fong 2011). They are mostly small (as small as 2cm) although some are very large (2m). Five nominal species are reported from the Tigris-Euphrates basin in Southwest Asia but the diversity there is very limited, compared to India for example.

The sisorid catfish family is characterised by a leathery scaleless skin, rounded to compressed body and a flattened head, short dorsal fin positioned anterior to the level of the pelvic fins, a spine in the dorsal fin (absent in some non-Iranian species) and in the pectoral fin, a well-developed adipose fin (confluent with caudal fin in some species), a short anal fin, paired fins horizontal, gill membranes generally united to the isthmus, anterior and posterior nostrils close together, distinct nasal barbel present, 4-6 pairs of barbels, body with small tubercles (unculi), and a distinct thoracic adhesive apparatus in Iranian species but absent in some other species. These catfishes are found in mountain streams where they use the adhesive apparatus to maintain position in the current. In Iran they are reputed to lie on their backs in the water to take a rest! They are also very resistant and can live for 6 hours wrapped in wet cloth, reviving when placed in an aquarium (R. Mehrani, pers. comm. 2000).

Genus *Glyptothorax* Blyth, 1860

There are about 73 species in this genus, found from Syria east to China and Indonesia. This genus is characterised by a flattened head, an adipose fin of moderate length, a short dorsal fin with a strong spine, the spine serrated anteriorly or posteriorly, or smooth, pectoral fin spine serrated posteriorly and in some with plicate skin ventrally, 4 pairs of barbels, maxillary barbels broadly based, an inferior and transverse mouth, villiform teeth on the roof of the mouth in two patches, eyes small and partly obscured by skin, gill openings wide, gill membranes joined to the isthmus, and an adhesive apparatus on the chest formed from plaits or folds of skin, often with a central depression.

The validity of the described *Glyptothorax* species in the Tigris-Euphrates has not been adequately resolved. Three other nominal species occur, or are recorded in literature, in addition to the two reported here from Iran, namely *G. armeniacus*, *G. steindachneri* and possibly *G. cous*. A single specimen of a sisorid catfish has been caught in the Yeşil Irmak of Anatolian Turkey at Taşova (40°46'N, 36°20'E) (Coad and Delmastro 1985). This Black Sea drainage specimen calls into question the utility of characters used in identifying and defining species in Southwest Asia. Its characters are a mixture of features shared by *G. armeniacus* and *G. silviae* and also see comments in the distribution section of *G. kurdistanicus*. Fresh material from the type localities, a wide range of specimens of both sexes, various age groups, from various localities, and with DNA data is not available to assess variation and resolve the species composition of the Southwest Asian fauna. Development of the ventral sucker, spots on the body, meristics and morphometrics vary within circumscribed distributional areas and cannot all be ascribed as unique, species-identifying characters. There may indeed be more than one species in the Tigris-Euphrates basin of Iran, with *G. kurdistancus* in northern Tigris tributaries and *G. silviae* the southern species. Exceptions to this simple approach do occur in characters mentioned above and many records need definitive verifcation.

Aglyptosternon Bleeker, 1862 (and such mispellings as *Aclyptosteron*, *Enclyptosternum* and variants - see Eschmeyer (1990) for details) are synonyms of *Glyptothorax* (Li 1986; Eschmeyer 1990). Confusion over the family placement of these fishes in various literature sources is reviewed in Banister (1980).

They are known generally as gorbeh mahi (= cat fish) or arteshi in Farsi. Arteshi (= soldier-like) may

be from their tank-like appearance or for their pigmentation which is said to resemble camouflage. Another general name is sag mahi (= dog fish). General names are not repeated below.

Kosswig (1951; 1952; 1955a; 1955b) notes the similarity at the generic level between Indian and African fishes, indicating that these fishes arrived in Africa from India after the desiccation of the Syrian-Iranian Sea in the Pliocene. The primary route, according to Kosswig and to Por (1987), was a northern one around the barrier of the Persian Gulf and Sea of Oman via northern Arabia, Syria and the Levant. Cooling conditions in these areas during the Pliocene and especially the Pleistocene glaciations, and arid climates at times, were unsuitable for tropical forms. These movements left a selection of fishes in what is now Iran including the sisorid catfish *Glyptothorax*. Menon (1954) considered that the members of this genus had spread westwards along the Himalayas as late as the early Pleistocene. A centre of origin in western Yunnan, and the southern slopes of the Himalayas, is advocated by Li (1986) who gives an overview of the genus. This author suggests that a Pliocene movement occurred westwards and that, as well, the distribution of *Glyptothorax* was influenced by Pleistocene glaciations. Their entry route into the Tigris-Euphrates basin is given as along the Amu Darya system.

Glyptothorax armeniacus (Berg, 1918)
(Figs. 18 & 19)
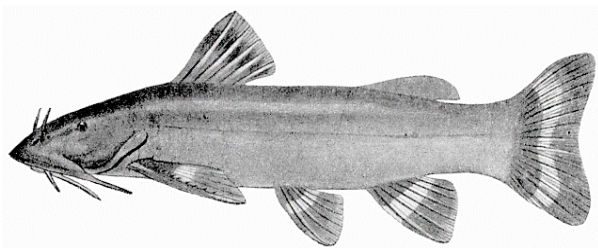
Fig.18. Line drawing of *Glyptothorax armeniacus* after Berg (1931).
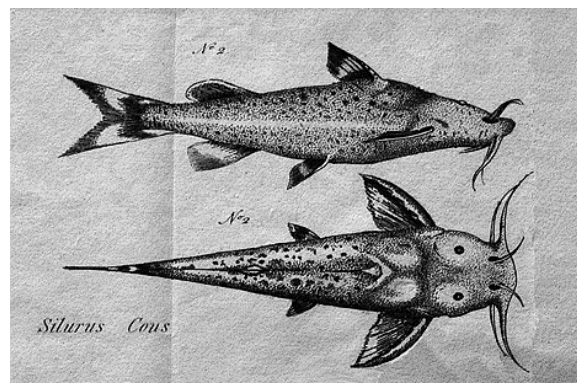
Described from the Euphrates River basin in the Mukhlassi-darasi River downstream from Chat and
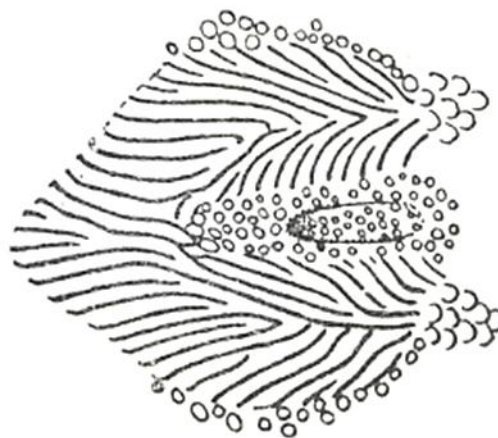
Fig.19. *Glyptothorax armeniacus* sucker, ventral view, after Berg (1931).

ca. 43km southeast of Erzurum in Turkey, but no Iranian record.

### *Glyptothorax cous* (Linnaeus, 1766)
(Fig. 20)

Fig.20. *Glyptothorax cous* from Russell (1794), scan from original in possession of B.W. Coad.

Reported from the Tigris River basin in Iraq but no Iranian record. Originally described from the Quweiq River at Aleppo, Syria. Species identity in the Tigris needs confirmation by specimens. See Banister (1980) for a brief history of the confusion surrounding the name of this species in the earlier literature.
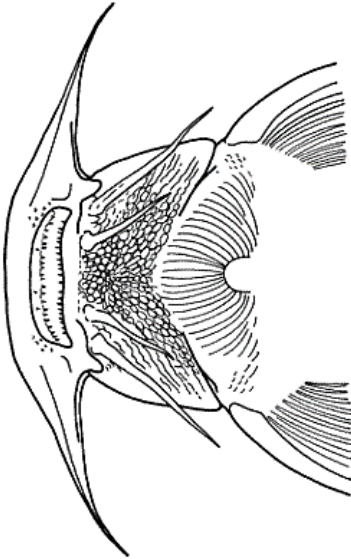
Glyptothorax kurdistanicus (Berg, 1931)
(Figs. 21-22)

Common names: Gorbehmahi-ye Kordestan (= Kordestan catfish). [Kordestan sisorid; Iran cat (Fricke et al. 2007)].

Systematics: This species was originally described in
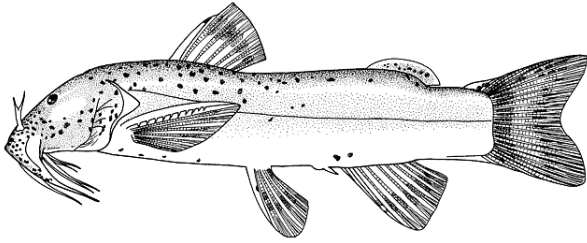
Fig.21. Line drawing of *Glyptothorax kurdistanicus* by S. Laurie-Bourque after Berg (1931).

Fig.22. Ventral head of *Glyptothorax kurdistanicus* showing sucker by S. Laurie Bourque after Berg (1931).

the genus *Glyptosternum*, an unjustified emendation of *Glyptosternon* McClelland, 1842 by Berg (1931). See Eschmeyer (1990) for further details on this genus name. The holotype of this species is in the Zoological Institute, St. Petersburg (ZISP 20780) and is in poor condition, the pectoral spines being damaged for example. It is an adult male. The collection date in Berg (1931) is 10 July 1914 (or 27 June old style). The type locality is "in Kurdistan, at the village Germau (or Germav), at the height of 1500m, during the works of the Turko-Persian delimitation commission. Germau (or Germav, Germaw) is situated in latitude 36°N southeast of Serdesht, on the western slope of the Sur-kei Range, in the basin of the river Bané, tributary to the Little Zab, which is tributary to the Tigris R.". Berg (1949) gives the variants Germab and Sar Dasht for the localities, Germab is probably Garmab and Bané is probably Baneh. The village of Germab could not be located in gazetteers or on maps with a relevant longitude but Sar Dasht (36°09'N, 45°28'E) and Baneh (35°59'N, 45°53'E) are evident and the locality is between them and lies in Iran.

Key characters: Berg (1931) separates this species from *G. armeniacus* by the broader than long adhesive apparatus which does not have pinnate lateral branches and these characters also contrast with *G. silviae*. The caudal peduncle is short (5.9-6.0 in standard length compared to 4.7-5.4 in *G. silviae*).

Morphology: Dorsal fin with 1 spine followed by 5-7 branched rays, anal fin with 2 unbranched rays followed by 7-9 branched rays (note that these fin ray counts in Berg (1931) do not agree with his figure). Pectoral fin with 1 spine and 7-9 branched rays. Total gill rakers 7-9, moderately long and reaching beyond the base of the second raker below when appressed. The adipose fin is short, much shorter than the distance between the dorsal and adipose fins. There are oblique osseus striae under the skin of the upper surface of the first pectoral ray. Head and body covered with minute, elongate tubercles oriented longitudinally but without striae. Tubercles are also present on the base of the caudal fin rays, adipose fin, base of the dorsal and pectoral fins, on the pectoral spine along its whole length both dorsally and ventrally, a few on the base of the pelvic fin rays and few to none on the belly particularly anterior to the pelvic fins. Tubercles on the side of the head are more rounded. The adhesive apparatus has a shallow central depression. Berg (1931) states that the upper jaw tooth patch has well-developed lateral rami, but these do not extend markedly from the main patch. The nasal barbel is short and does not extend back to the eye. The maxillary barbel is shorter than head length and the mandibular and mental barbels are progressively shorter. The gut is an elongate s-shape after a muscular stomach.

Sexual dimorphism: Unknown.

Colour: Overall colour grey to brown with large, obvious, round, black spots and blotches on the sides

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or with small round black spots about eye size. All fins with broad black central band and variably developed basal bar. Basal bar most evident on the caudal fin. Adipose mostly covered with a large dark spot but dorsal and posterior edges hyaline.

Size: Attains 267.2mm total length.

Distribution: Found in the Tigris-Euphrates basin including that part in Iran as described above for the type locality. Abdoli (2000) has mapped it in the upper Karun, middle and lower Dez, middle and upper Karkheh, Kashkan, Simarreh and lower Gav Masiab Rivers. Jawad et al. (2009) record it tentatively from the Garaf River of the lower Tigris River basin in Iraq. Photographs of the specimen (sent by L. A. Jawad 27 November 2014) show a fish with an adhesive disc of *kurdistanicus* form but a caudal peduncle length and lack of spots more typical of *silviae*. All the more southern localities outside the Little Zab River basin in the north need verification.

Zoogeography: The relationships of this species, as with other members of the genus, is presumably with the more diverse fauna to the east.

Habitat: Unknown in detail but it is assumed to be in rocky and gravelly rivers which provide hiding places.

Age and growth: Unknown.

Food: Unknown for Iran but Turkish specimens contained fish remains in the stomach.

Reproduction: Unknown.

Parasites and predators: Unknown.

Economic importance: This species is not of any direct economic importance.

Conservation: This species is poorly known in Iran and may be rare enough to warrant conservation efforts.

Sources: Further details on collections examined can be found in the museum catalogues.

Type material: See above.

*Iranian material:* None.

Comparative material: BM(NH) 1974.2.22:1789, 346.6mm standard length, Iraq (no other locality data); BM(NH) 1968.12.13:465-470, 4, 53.7-76.8mm standard length, Syria, Euphrates at Mayadine (35º01'N, 40º27'E); CMNFI 1980-0148, 1, 123.3mm standard length, Turkey, Elazig, Keban Dam on Murat Nehri; CMNFI 1980-0805, 1, 196.1mm standard length, Turkey Karasu (no other locality data); CMNFI 1980-1036, 2, 123.2-223.1mm standard length, Turkey, Elazig, Keban Dam on Murat Nehri; SMF 23676, 4, 229.0-297.7mm standard length, Syria, bei al-Hasaka (36º30'N, 40º44'E); SMF 23677, 2, 65.7-122.0mm standard length, Syria, Wadi Furati (36º26'N, 40º52'E); ZMH 4430, 2, 129.8-133.3mm standard length, Turkey, Kemaliye Karasu (no other locality data).

Glyptothorax silviae Coad, 1981
(Figs. 23 & 24)
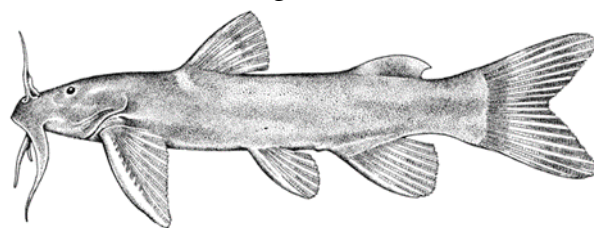
Fig.23. Line drawing of *Glyptothorax silviae* by C.D. Douglas.
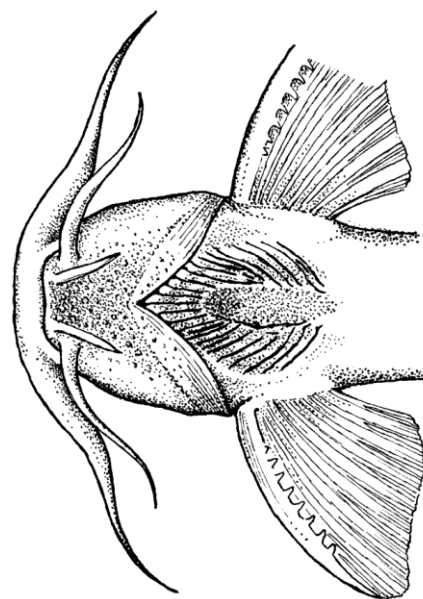
Fig.24. Ventral head of *Glyptothorax silviae* showing sucker by C. D. Douglas.

Common names: Gorbehmahi-ye jonubi or jonub (= southern catfish). [Sylvie's sisorid, southern sisorid].

Systematics: The holotype is in the Canadian

Museum of Nature, Ottawa under CMNFI 1979-0390A and measures 67.6mm standard length. It is from "Khuzestan, stream 3km south of Bagh-e Malek, tributary to Rud-e Zard or Ab-e Ala in the drainage of the Jarrahi River, 31°29'N, 49°54'30"E. Two paratypes from the same locality measure 44.0-51.5mm standard length and are under CMNFI 1979-0390B, a third paratype measuring 42.3mm standard length under CMNFI 1979-0389 is from a "stream tributary to Rud-e Zard or Ab-e Ala, 1km south of Bagh-e Malek, in the drainage of the Jarrahi River, 31°31'N, 49°53'30"E", and a fourth paratype measuring 134.8mm standard length under CMNFI 1979-0280 is from "Lorestan, river at "Pol-e Chubee" in Kashkan River drainage on Khorramabad to Kermanshah road via Nurabad (either Kaka Reza River at 33°43'N, 48°15'E or its tributary at 33°47'N, 48°12'E)".

Key characters: The head and body dorsolaterally lack striated or elongate tubercles (present in *G. kurdistanicus*), the thoracic adhesive apparatus is longer than wide (the reverse in *G. kurdistanicus*) and the caudal peduncle is long (4.7-5.4 in standard length, 5.9-6.0 in *G. kurdistanicus*) (note: very small *G. silviae* may have a shorter caudal peduncle).

Morphology: Dorsal fin spines are smooth and number 2, branched rays 6-7, usually 6, anal fin branched rays 7-9, usually 8, pectoral fin branched rays 7-9, pelvic fin branched rays 5, total gill rakers 6-11, rakers reaching the second adjacent raker when appressed but a few fish of equal size have shorter rakers, retrorse pectoral fin spine teeth 7-16, the number increasing with size of the fish, and total vertebrae 35-38. The adipose fin is long, its length being about equal to the distance between the dorsal fin insertion and the adipose origin (0.9-1.1). The pectoral fin is short and does not extend back to the pelvic fin origin. The caudal peduncle is deep (depth 47-62% of caudal peduncle length). The "sucker" or thoracic adhesive apparatus has pinnate lateral branches and is usually markedly longer than wide with a wide and long central depression. The head and body are finely papillose, particularly on the ventral surface. Anterior to the adhesive apparatus the ventral head surface is strongly papillose, becoming less developed laterally. The upper lip is much more strongly papillose than the weakly papillose lower lip. The diploid chromosome number is 2n=52 and the karyotype consists of 9 pairs of metacentric, 14 pairs of submetacentric and 3 pairs of subtelocentric chromosomes. The arm number is 98 (Esmaeili et al. 2009).

Sexual dimorphism: Unknown.

Colour: The body is nearly immaculate but in live fish is mottled light lime-green, grey-green, brown or grey. All fins have a central black bar on a salmon-pink, peach or yellow coloured background. The thoracic adhesive apparatus is pink due to an underlying vascular supply. The eye is red.

Some preserved fish may have very few scattered brown or black spots dorsally and laterally on an otherwise immaculate body. Spotting is rarely extensive and usually limited but occurs in both large and small fish and in fish from the same locality. The overall body colour is brown becoming pale brown or cream on the belly. The base of the caudal fin has a wide black bar separated from a second distal bar by an unpigmented section of the fin rays. The central-most 4 rays of the caudal fin are variably black in the otherwise unpigmented bar. The posterodorsal and posteroventral corners of the caudal lobes are not pigmented but the margins of the lobes are black. The central portion of the adipose fin is black with the margins unpigmented in smaller specimens. There is no black pigment on the basal part of this fin. The paired fins and the anal fin are unpigmented distally but become yellowish with fleshy tissue proximally and then brown at their bases. A central band is not well-defined in small specimens. A light patch is found on the back at the dorsal fin origin and at the dorsal fin insertion. The dorsal fin is darkly pigmented and a central black band is apparent although poorly defined. The adult female is generally darker than the smaller male fish in the type series such that the caudal fin bars are not as well defined. The adipose fin is dark brown and

the light patches at the dorsal fin are not distinctive. However the bars on the dorsal, anal and paired fins are more obvious.

Size: Reaches 31.0cm standard length (Raissy & Ansari 2012) although other reports are 11.9cm total length (Amini Chermahini et al. 2014) and 12.4cm total length (Gerami et al. 2014).

Distribution: Known only from rivers draining to the Persian Gulf in southwestern Iran (see type material localities above) (Njafpour 1997; Coad 2006). Abdoli (2000) also maps it in the upper Karun and middle to lower Khersan, and middle to lower Dez rivers in the Tigris River basin and in the Mand (Mond) and Shur rivers of the Persian Gulf basin (the latter tributary to the Dasht-e Palang River). Raissy et al. (2010) and Raissy & Ansari (2012) record it from the Armand River in Chaharmahal va Bakhtiari Province (upper Karun River basin), Sayyadzadeh et al. (2013) from the Simarreh River, Teimori et al. (2010) from the Kohmarreh Sorkhi River of the Helleh River basin (Persian Gulf basin), Amini Chermahini et al. (2014) from the Marun River, Gerami et al. (2014) from the Cholvar River, a Karun River branch, and Tabiee et al. (2014) from the Beshar River in Kohkiluyeh and Boyer Ahmadi Province (as cf. *silviae*). Also reported from the Gav Masiab, Haramabad, Kashkan, Karun (and its upper branches), Hofel, Abshar, Armand, Shahreyari, Lordegan, Ab-e Bazoft, Dez, Karkheh, A'la, Jarrahi, Rud–e Zard (Fig. 25), Zohreh and Dalaki rivers.

Zoogeography: Distribution in the Gulf basin is probably a relict of the late Pleistocene when the Tigris-Euphrates flowed down a drained Gulf, receiving tributaries now isolated by the post-Pleistocene rise in sea level (Coad & Krupp 1983).

Habitat: Their ability to use their sucker for clinging to objects can be seen in plastic jars where small specimens will adhere to the sides out of the water. This species attaches to rocks and pebbles in fast water and can move against the current (Teimori et al. 2011). They also occur in less fast water, under or behind rocks.

Age and growth: Esmaeili & Ebrahimi (2006) give a

Fig.25. Zard Rud at Bagh-e Malek, 20 September 1995, habitat of *Glyptothorax silviae*, B.W. Coad.

significant length-weight relationship based on 10 fish measuring 5.60-10.66cm fork length. The *a*-value was 0.0164 and the *b*-value 2.975 (a *b*-value <3 indicating a fish that becomes less rotund as length increases and a *b*-value >3 indicating a fish that becomes more rotund as length increases). Esmaeili et al. (2014b) based on 16 fish, 6.12-13.0 cm total length gave an *a* value of 0.010 and a *b* value of 2.98. Amini Chermahini et al. (2014) examined 277 fish from the Marun River and found the length-weight relationship was W=0.006 TL$^{3.205}$ indicating allometric growth and was not significantly different between sexes. Overall condition factor was 0.62 and it and the sex ratio were not significantly in males and females. Esmaeili et al. (2104) give a *b* value of 2.98 for 16 fish 6.12-13.0cm total length from the Tigris River. Gerami et al. (2014) give a length-weight relationship for 89 fish 5.2-12.4cm total length from

the Cholvar River as TL=8E-06W$^{3.045}$.

Food: Amini Chermahini et al. (2014) found this species fed only on aquatic insects in the Marun River. This diet included Plecoptera, Ephemeroptera, Diptera, Hemiptera, and Trichoptera. Small, medium and large fish had a similar diet. The greatest intensity of feeding was in January-February andAugust-September with the least in April-May and October.

Reproduction: The largest specimen in the type series is a female bearing eggs and was caught on 6 July. The breeding season is probably the summer months. Amini Chermahini et al. (2014) confirmed this and found their Marun River fish to reproduce in June-September. Absolute and relative fecundity were 1129 eggs/fish and 105 eggs/g body weight on average. Egg size ranged from 0.994 to 1.76mm with a mean of 1.29mm. The highest gonadosomatic indices were observed in June-July.

Parasites and predators: Raissy et al. (2010) found ichthyophthiriasis (infection with *Ichthyophthirius multifilis* - ich or white spot disease), which cause epizootics in wild and cultured fishes, in fish identified as this species from the Armand River in Chaharmahal va Bakhtiari Province, although the infection rate was the lowest in the fish species studied. In the same locality, Raissy & Ansari (2012) also reported *Rhabdochona denudata* (Nematoda) from this catfish. Sayyadzadeh et al. (2013) record fish from the Simarreh River with the anchor worm *Lernaea* sp.

Economic importance: This species is not of any direct economic importance.

Conservation: Collections with an electroshocker in 1995 showed this species to be common in the Rud-e Zard. However, in the Gulf basin it may be under threat from water extraction and diversion schemes, drainage rehabilitation which alters the system, drought, domestic and agricultural pollution, and through competition with exotics from fish farms (Teimori et al. 2010).

The distribution of this and related species should be determined by further field work using electroshocking equipment to extract specimens from under rocks. The validity of the nominal Tigris-Euphrates basin species, including this one, needs examination using large series of adult and young which are not yet available in collections. Variation in critical characters is poorly known because of this shortage of specimens. Molecular and chromosomal techniques may provide additional characters.

Sources: Further details on collections examined can be found in the museum catalogues.

Type material: See above.

Iranian material: CMNFI 1993-0143, 1, 53.2mm standard length, Bushehr, Dalaki River (no other locality data); CMNFI 1995-009A, 2, 33.8-36.2mm standard length, Khuzestan, A'la River at Pol-e Tighen (31°22'30N, 49°53'E); CMNFI 2008-0120, 4, 26.2-33.9mm standard length, Khuzestan, Rud Zard at Rud Zard (31°22'N, 49°43'E); CMNFI 2008-0121, 1, 26.5mm standard length, Khuzestan, Rud Zard at Bagh-e Malek (31°32'N, 49°55'E); CMNFI 2008-0125, 1, 249.0mm standard length, Khuzestan (no other locality data); CMNFI 2008-0126, 2, 219.5-223.5mm standard length, Khuzestan, near Susangerd, Karkheh River basin (31°32'N, 48°11'E); CMNFI 2008-0127, 1, 96.5mm standard length, Khuzestan (no other locality data); CMNFI 2008-0128, 1, 79.9mm standard length, Khuzestan, Karun River at Khobeyneh (31°15'N, 48°34'E);); CMNFI 2008-0129, 2, 41.4-65.3mm standard length, Khuzestan, Rud Zard at Bagh-e Malek (31°32'N, 49°55'E); CMNFI 2008-0151, 2, 85.1-136.1mm standard length, Kermanshah, Gav Masiab (34°10'44"N, 47°20'48"E); CMNFI 2008-0182, 1, 81.9mm standard length, Chahar Mahall va Bakhtiari, Ab-e Bazoft (no other locality data); CMNFI 2008-0184, 2, 57.4-58.8mm standard length, Chahar Mahall va Bakhtiari, Armand River (no other locality data); CMNFI 2008-0185, 1, 77.3mm standard length, Chahar Mahall va Bakhtiari, Sulgan River (31°30'N, 50°50'E); CMNFI 2008-0190, 1, 82.7mm standard length, Chahar Mahall va Bakhtiari, Shahreyari River (32°15'N, 50°17'E); CMNFI 2008-0230, 1, 235.0mm standard length,

Khuzestan, Andimeshk, Dez River (32°30'N, 48°26'E).

Glyptothorax steindachneri (Pietschmann, 1913)

Originally described from the Tigris River basin at Mosul in Iraq. The two syntypes in the Naturhistorisches Museum Wien have not been located (1997 visit) and the brief description is without figures or details of the thoracic adhesive apparatus. Its validity is in question. See Coad (2010) for a summary of the description of this species. Not reported from Iran.

Acknowledgements

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